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Revolution at Sea Starts Here

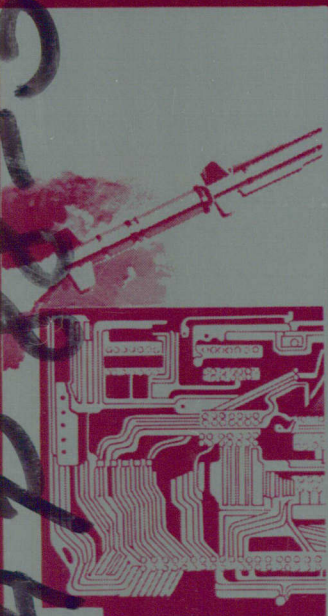
A 1987 History of the
Naval Surface Warfare Center

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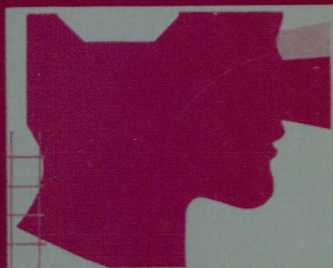
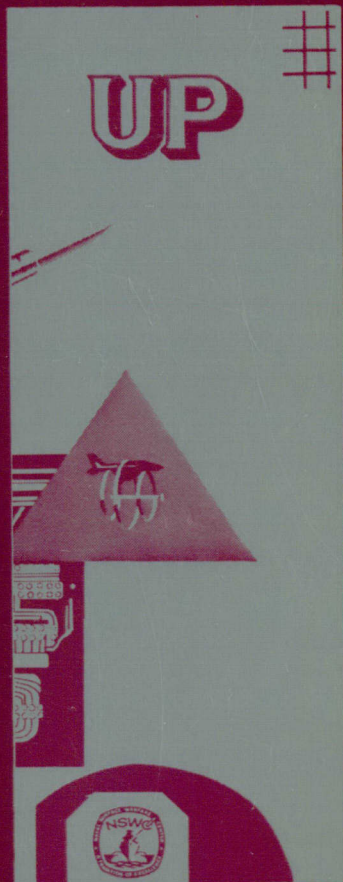
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Revolution at Sea Starts Here

A 1987 History of the Naval Surface Warfare Center



1 March 1988

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Preface

This document records the major activities and achievements of the Naval Surface Warfare Center during the calendar year 1987, submitted in compliance with OPNAVINST 5750.12D of 17 Nov 1987. The report was prepared by **Sylvia G. Humphrey**, with editorial assistance by **Edward G. Berlinski** and **Cynthia Miller**. Material for the command history was gathered from official reports, management data, and personal interviews, and covers only unclassified information.

The report chronicles major NSWC events in 1987, covers corporate issues and studies, highlights of major technical achievements, and presents assessments of their impact on the Navy. The History discusses the state of the technology base followed by a list of awards and honors received by NSWC employees. Additional documentation—an integral part of this command history—is presented in the Appendices.

Acknowledgement

The author wishes to thank numerous NSWC employees who have been extremely helpful in the production of this command history. In addition to the outstanding response received from the Center's technical department heads and senior scientists and engineers who worked closely with Humphrey, Berlinski and Miller in shaping this history, there were other individuals—**James L. Sloop**, **Sally H. Clark**, **CDR J. N. Heuring**, **USN**, **Carroll T. Shelton**, **Thomas W. Truslow**, **CDR Donald Rowe**, **USN**, **LT Gary G. Durante**, **USN**, **Karen A. Melichar**, **Edward E. Blake**, **Mary H. Hagen**, **Mark E. Chase**, **Gary Kendrick**, **Barbara Wisdom**, **George L. Hamlin**, **Pamela O. Lama**, **Marcella Westermeyer**, and **Dave Meggs**. Without their professional and/or technical assistance and cooperation, it would have been impossible to complete this history on time.

Foreword



Today's Surface Navy is on the move in all corners of the globe. International events continue to propel our ships and crews into situations that are critical to the success of this nation's national security objectives. Our Surface Warriors operate on the forward edge...witness our operations in the Persian Gulf.

Success in that area of the world has had to be earned every hour of every day in the face of difficult challenges. Critical to our success has been the tremendous talent and dedication of our Surface Warriors. Their superb performance, coupled with the best weapons and combat systems available to the fleet has made our national strategy and policy in that area highly successful. As a result, our policy in that region has gained credibility.

The pages that follow tell an impressive story about the research and development being conducted at NSWC. The Surface Warriors at our "R&D Lab" at White Oak and Dahlgren continue to sharpen the qualitative edge we possess in Surface R&D...an edge that ensures that the fleet is equipped with the very best combat systems ever put to sea by any Navy.

This is not an easy task. However, in this age of microchips and superconductors, our scientists and engineers at NSWC have remained on the forefront of newly emerging technologies. It is clear from reading NSWC's 1987 Command History that the men and women of NSWC remain dedicated to developing the very best weapons and combat systems for the Surface Navy.

The superb people at NSWC are vital players in our Navy's Revolution at Sea. In an R&D sense, the Revolution at Sea begins ashore. The wealth of ideas of NSWC's scientists and engineers becomes tomorrow's technology. They are the vital link to the Surface Warriors of today and tomorrow who depend on the weapons systems seen in these pages. The Surface Navy's ability to carry out its varied and important missions around the world is in many ways dependent on the superior quality of work being accomplished at the Naval Surface Warfare Center.

To the men and women who carry out the R&D mission at NSWC, I say, keep up the great work! The Surface Navy needs you! On behalf of the entire Surface Navy, I congratulate you on a highly successful 1987.

John W. Nyquist
Vice Admiral, USN
Assistant Chief of Naval Operations
for Surface Warfare (OP-03)

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NSWC Beginnings

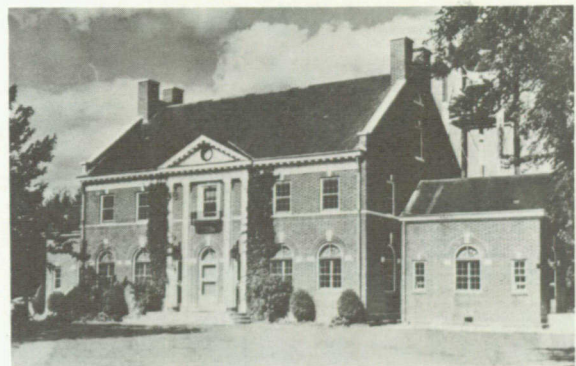
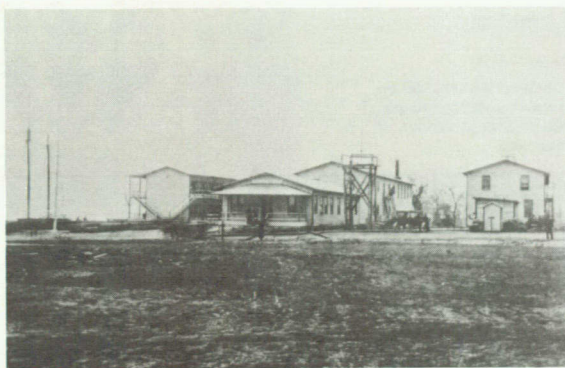
NSWC Beginnings

The Naval Surface Warfare Center builds on a long RDT&E tradition dating back to World War I of research, development, test, and evaluation for the Surface Navy. The Center was established in 1974—known then as the Naval Surface Weapons Center—brought about by the merger of the Naval Weapons Laboratory at Dahlgren, Virginia, and the Naval Ordnance Laboratory at White Oak, Maryland. This merger combined each site's high-caliber human resources and extensive technical facilities, and resulted in the formation of the largest RDT&E Center in the Navy in terms of personnel and budget.

Dahlgren's roots go back 70 years when it was established as the Lower Station of the Naval Proving Ground at Indian Head, Md. The site at Indian Head had become inadequate with advances in ordnance during World War I, and a range of 90,000 yards down the Potomac River was provided by establishing the Lower Station. The station was named in honor of Rear Admiral John Adolphus Dahlgren, "the father of modern naval ordnance." However, Dahlgren was then an extremely remote area. Thus, to recruit and retain the highly specialized workforce required, the Navy

provided housing, food and medical services, schools and recreational facilities, and many other community services. In 1932 the station was designated the Naval Proving Ground, Dahlgren. Until World War II, the principal work at Dahlgren involved proofing and testing every major naval gun, along with the rounds they delivered for fleet use. This was done at the Main Range Gun Line, which faces down the Potomac River. While the Gun Line still performs that vital role, the scope and depth of work at Dahlgren have grown tremendously. Reflecting this expanded mission and Dahlgren's transition to a broad-based R&D capability, the name was changed in 1959 to the Naval Weapons Laboratory. Concurrently, the pace of change in the Dahlgren area has relieved the Navy of much of its role in providing community services. Dahlgren now has a land area of 4,300 acres which includes a 20-mile downriver range for projectile testing.

White Oak traces its history to the establishment in 1918 of a Mine Unit at the Washington Navy Yard. A small group of experts was charged with making improvements in naval mines. Shortly afterward, a second group, the Experimental Ammunition Unit,



Dahlgren Administration Buildings, 1918 and 1945.

1918

**BUORD MINE UNIT
(MINE LABORATORY)
WASHINGTON NAVY YARD**

Officer In Charge

LT L. W. McKeenan	Feb 19 - Aug 19
LT W. F. Palmer	Dec 19 - Jan 22
LT A. W. Ashbrook	Jan 22 - Jun 23
LCDR J. G. Jennings	Jun 23 - Dec 23
LCDR J. G. Jones	Dec 23 - Jun 26
LCDR T. J. Keliher, Jr.	Jun 26 - May 28
LT F. J. Hanafee	May 28 - Jan 29

1920

**EXPERIMENTAL
AMMUNITION UNIT
INDIAN HEAD**

**EXPERIMENTAL
AMMUNITION UNIT
WASHINGTON NAVY YARD**



16 JAN 1929

**NAVAL ORDNANCE LABORATORY
WASHINGTON NAVY YARD**

Officer In Charge

LT F. J. Hanafee	Jan 29 - Jun 29
LCDR T. D. Westfall	Jul 29 - May 31
LCDR F. E. Beatty	May 31 - May 33
LT E. M. Crouch	Jun 33 - Apr 35
LCDR J. R. Lannom	Apr 35 - Jun 36
LCDR G. M. O'Rear	Jun 36 - May 38
CDR J. B. Glennon	Aug 38 - Nov 43
CAPT R. D. Bennett	Nov 43 - Dec 43
CAPT W. G. Schindler	Dec 43 - Nov 45
CAPT F. S. Withington	Dec 45 - Oct 46

Principal Engineer

Dr. R. C. Duncan Mar 42 - Jan 44

Chief Physicist

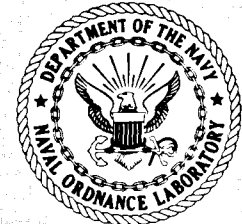
Dr. R. C. Duncan Jan 44 - Feb 44

**Director of Technical
Development**

CAPT R. D. Bennett Feb 44 - Jun 45

Technical Director

CAPT R. D. Bennett Jun 45 - Apr 47



1945-50*

**NAVAL ORDNANCE LABORATORY
WHITE OAK**

Commanding Officer

CAPT F. S. Withington	Oct 46 - Apr 47
RADM F. E. Beatty	Apr 47 - Nov 48

Commander

RADM F. E. Beatty	Nov 48 - Mar 50
RADM B. H. Hanton	Mar 50 - Jul 50
RADM W. G. Schindler	Jul 50 - Jun 52
CAPT E. L. Woodyard	Jun 52 - Jun 54
CAPT J. T. Hayward	Jun 54 - Feb 56
CAPT W. W. Wilbourne	Feb 56 - Dec 58
CAPT M. A. Peterson	Dec 58 - Nov 59
CAPT J. A. Quense	Nov 59 - May 60
CAPT W. D. Coleman	May 60 - Jul 62
CAPT R. E. Odensing	Jul 62 - Jun 65
CAPT J. A. Dare	Jul 65 - Aug 66
CAPT E. F. Schreiter	Oct 66 - Jun 69
CAPT G. G. Ball	Aug 69 - Jun 71
CAPT R. Ennis	Jul 71 - Sep 71
CAPT R. Williamson II	Oct 71 - Sep 74

Technical Director

Dr. R. D. Bennett Apr 47 - Nov 54

Dr. G. K. Hartmann Feb 55 - Jun 73

* The White Oak cornerstone was laid on 15 Aug 1946. Various operating groups moved up from Washington as various buildings were completed.



1 SEP 1974

NAVAL SURFACE

Commander

CAPT R. Williamson II	Sep 74 - Mar 75
CAPT C. J. Rorie	Mar 75 - Sep 77
CAPT P. L. Anderson	Sep 77 - Aug 81
CAPT J. E. Fernandes	Aug 81 - Jun 83
CAPT J. R. Williams	Jun 83 - Aug 86
CAPT C. A. Anderson	Aug 86 - Present



1 AUG 1987

NAVAL SURFACE

JUN 1918

**LOWER STATION, DAHLGREN
NAVAL PROVING GROUND
INDIAN HEAD**

**Inspector of Ordnance
in Charge**

CDR H. E. Lackey	Jan 17 - Mar 20*
CAPT J. W. Greenslade	Mar 20 - Jun 23
CAPT C. C. Block	Jun 23 - Sep 23
CDR A. C. Pickens	Sep 23 - Nov 25
CAPT H. R. Stark	Nov 25 - Sep 28
CAPT H. F. Leary	Oct 28 - May 31
CDR G. L. Schuyler	May 31 - Jul 32

**Senior Scientist
Dr. L. T. E. Thompson**

1923 - 1942

* CDR (later CAPT) Lackey was IOC of NPG Indian Head at the time the Dahlgren Station was established.

JUL 1932

**NAVAL PROVING GROUND
DAHLGREN**

**Inspector of Ordnance
in Charge**

CAPT G. L. Schuyler	Jul 32 - Jul 34
CAPT W. R. Furlong	Jul 34 - May 36
CAPT C. R. Robinson	Jun 36 - Dec 38
CAPT J. S. Dowell	Dec 38 - Apr 41
CAPT D. I. Hedrick	Apr 41 - Apr 43

**Director of Research
Dr. C. C. Bramble**

1951 - Jan 54

Commanding Officer

CAPT D. I. Hedrick	Apr 43 - Jun 46
RADM C. T. Joy	Jun 46 - Nov 48

Commander

RADM C. T. Joy	Nov 48 - Aug 49
RADM W. A. Kitts III	Sep 49 - Jun 51
RADM Irving T. Duke	Jun 51 - Jul 52
CAPT J. F. Byrne	Jul 52 - Jun 56
CAPT R. D. Risser	Jul 56 - Sep 56
RADM G. H. Wales	Sep 56 - Aug 57
CAPT R. D. Risser	Aug 57 - Oct 57
CAPT M. H. Simons, Jr.	Oct 57 - Aug 59



15 AUG 1959

**NAVAL WEAPONS LABORATORY
DAHLGREN**

Commander

CAPT A. R. Faust	Aug 59 - Mar 60
CAPT T. H. Morton	Mar 60 - Aug 61
CAPT R. F. Sellars	Aug 61 - Jun 64
CAPT G. G. Ball	Jul 64 - Sep 64
CAPT W. A. Hasler, Jr.	Sep 64 - Jul 68
RADM J. D. Chase	Aug 68 - Jul 69
CAPT S. N. Anastasion	Jul 69 - Jan 72
CAPT J. H. Burton	Jan 72 - Aug 72
CAPT R. F. Schniedwind	Aug 72 - Jul 73
CAPT R. B. Meeks, Jr.	Jul 73 - Sep 74

Technical Director

Dr. R. H. Lyddane	Mar 56 - Dec 64
B. Smith	Aug 64 - Jun 73
J. E. Colvard	Jul 73 - Sep 74



WEAPONS CENTER

Technical Director

Dr. J. E. Colvard	Sep 74 - Apr 80
R. S. Vaughn	Nov 80 - Apr 83
Dr. L. L. Hill	Apr 83 - Present

WARFARE CENTER



joined the mine developers. In 1929, these two groups were consolidated and designated as the Naval Ordnance Laboratory (NOL). As World War II approached, NOL operated under a greatly expanded mission and hundreds of technical personnel were recruited to support the war effort. During the war, NOL's principal achievements were the degaussing program for naval and merchant ships and the design of many ordnance devices, including the mines used to successfully close down the Japanese home waters. Anticipating NOL's future needs, the Navy acquired a large tract of land at White Oak, Md., to which the laboratory moved in the late 1940s. The interests and capabilities of NOL led to a broad expansion in activities in its suburban Washington location, which now comprises more than 200 buildings on about 730 acres. As the tide of Washington's growth continued to surge, NOL became a focal point of expertise in every field of physical science and engineering.

On 1 August 1987, the Naval Surface Weapons Center changed its name to the Naval Surface Warfare Center—to more accurately reflect its increasing involvement in all aspects of surface warfare. This action reflects the continual evolution of NSWC to keep pace with the Surface Navy's scientific and technical requirements.

Since 1974, both NSWC and the Navy have undergone a revolution in their approach to surface warfare. With the advent of many systems such as AEGIS, we no longer think in terms of individual weapons but rather in terms of an integrated weapons system together with its platform. The concept of the battle force is changing the character of these systems and the manner in which they are employed. NSWC, while retaining its weapons and components mission, now has leadership roles in surface ship combat systems engineering and integration and in surface warfare analysis.



Mine Building at Washington Navy Yard that housed the early Naval Ordnance Laboratory before it moved to White Oak, Md.

NSWC in 1987

NSWC In 1987

The Naval Surface Weapons Center's mission is to be the principal Navy RDT&E Center for surface ship warfare systems, ordnance, mines and strategic systems support. NSWC, with its primary mission in Surface Warfare, complements other Navy laboratory/centers that have primary missions in Air Warfare, Underwater Warfare, and Naval Vehicles.

NSWC, an industrially funded Center, performs technical support for customers in the Navy and other defense activities that need technical products and services for ship combat systems, ordnance, naval mines, and strategic systems. The Center fosters technological innovation and ensures that appropriate technology is applied to the Navy's most challenging problems. The Center establishes and maintains timely technologies, transitions the most efficient and effective technologies through development into systems that will be deployed, or introduces them into existing systems. The Center responds fully to threat projections and operational concerns of the Navy. The Center staff maintains a high professional level by active involvement in all

phases of the development process—from basic research to in-service engineering.

NSWC has a diverse and complex mix of facilities required to support R&D projects. These include chemistry, plastics, metallurgy, robotics, and explosive laboratories; hydroballistics, hydroacoustic, and aerodynamic test facilities; electromagnetic and environmental simulation facilities; and combat/weapon systems integration and evaluation facilities. NSWC also operates major field facilities and test ranges at Ft. Lauderdale, Fla., Ft. Monroe, Va., and Wallops Island, Va.

The funding for NSWC in 1987 totaled more than \$590 million. The Naval Sea Systems Command continued, as in past years, to be the Center's major sponsor for its technical programs, funding about 48 percent of its technical programs. At the end of 1987, NSWC employed 5,194 civilians, including 2,482 engineers and scientists. The Center's military complement in 1987 included 33 officers (in senior managerial billets and line assignments) and 67 enlisted personnel (many in specialized ratings).



Over NSWC Dahlgren

NSWC functions match the entire spectrum of technical activities for analyzing Navy requirements, advancing Navy technology, developing and acquiring combat systems, and supporting those systems deployed in the fleet.

The Center provided research, development, and/or support in the following major fields of effort in 1987:

Combat Systems: AEGIS; TOMAHAWK; and Warfare Systems Architecture and Engineering (WSA&E).

Weapon Systems: AEGIS Gun Weapon System; STANDARD Missile; Vertical Launching System; TARTAR; 16-inch Gun Munitions; Aero-Structures Technology; DRAGON Missile System; the Shoulder-Launched Multipurpose Assault Weapon (SMAW); and NATO AAW 5-inch Guided Projectile.

Underwater Weapon Systems: Advanced Sea Mine; QUICKSTRIKE; CAPTOR; SEAL

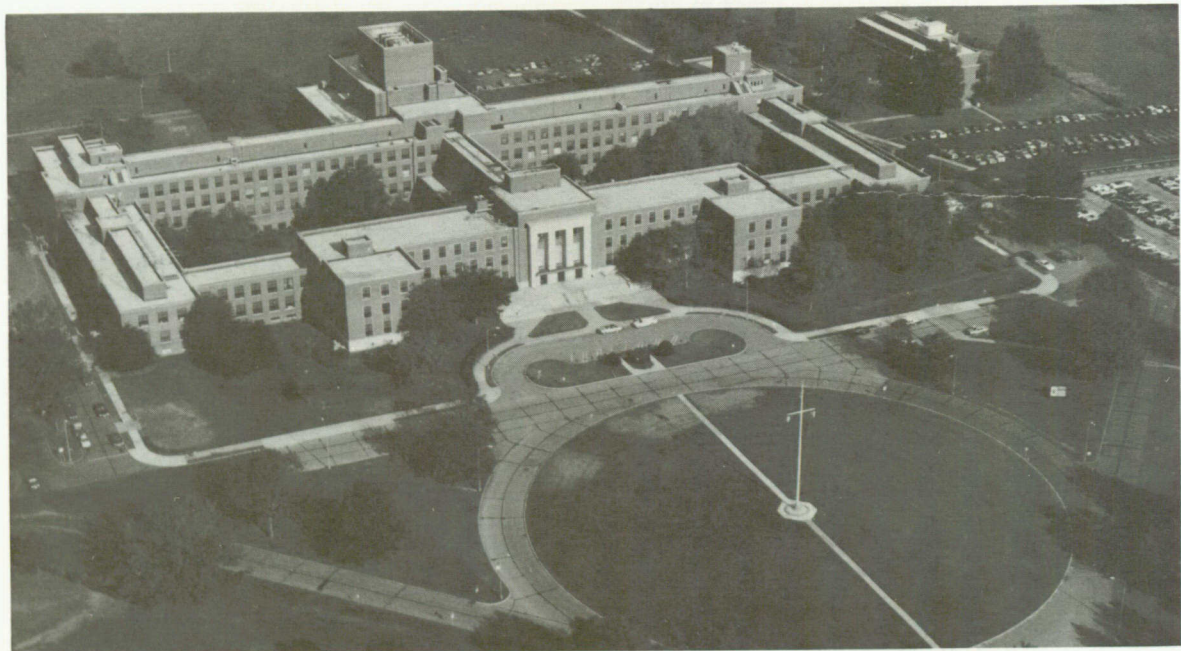
Weapons; Mine Improvement Program; Torpedo Mk 50; and AN/SQQ-32.

Strategic Weapons Systems: Mk 5 Re-entry Body; Strategic Defense Initiative (SDI) Simulator; Global Positioning System (GPS) Geodetic Receiver; and TRIDENT II.

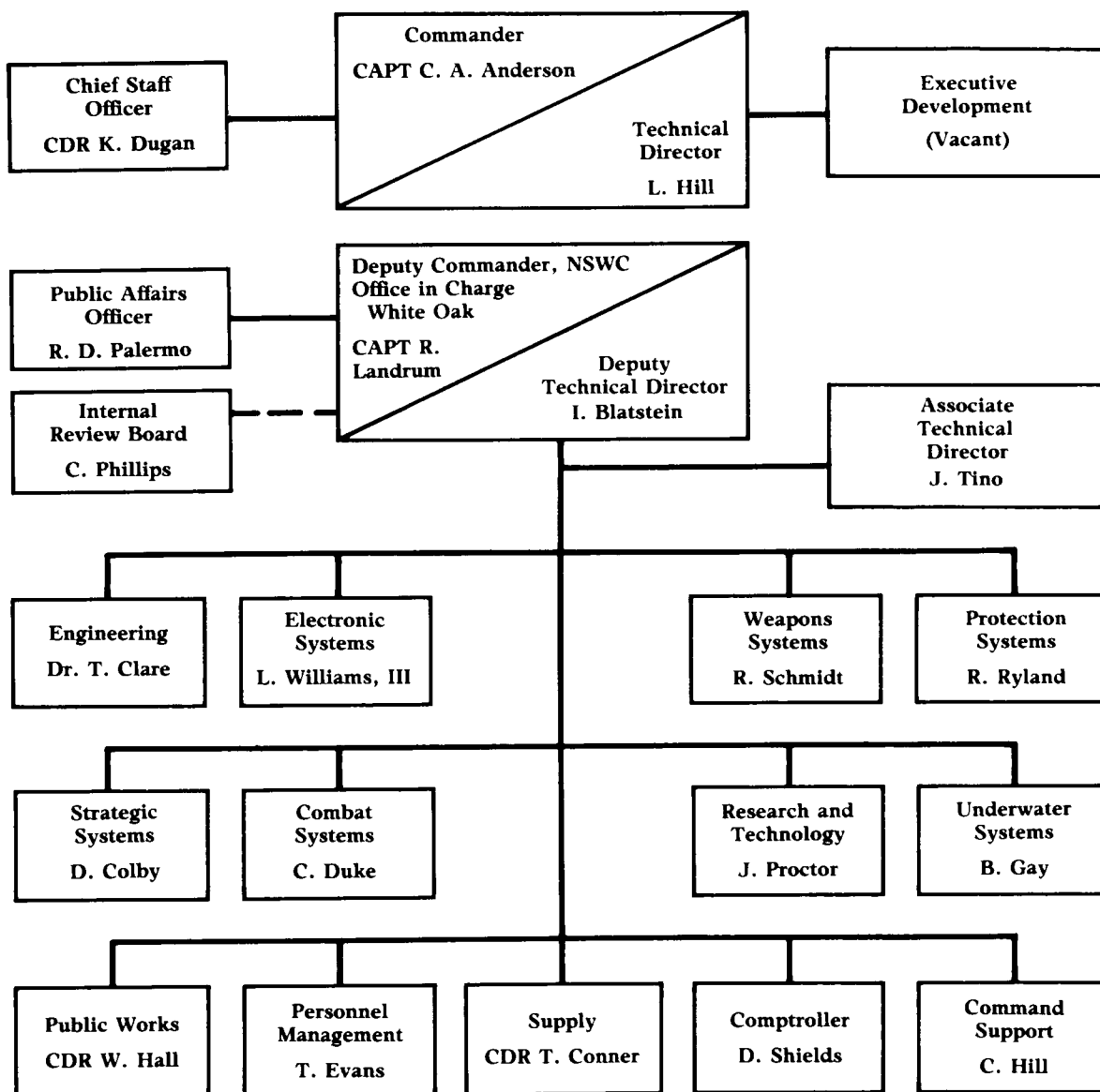
Electronics Systems: AN/SPY-1 Radar; AN/SLQ-32(V); Intelligence Systems; MAGIS/IAC Afloat Intelligence Center; SADIS AN/SAR-8; EW Integration; and Multisensor Integration.

Protection Systems: CASINO; Nuclear Survivability of Surface Ships; Shipboard Nuclear Weapon Security; Surface System Electromagnetic Compatibility; Hazards of Electromagnetic Radiation to Ordnance (HERO); Magnetic Silencing; and CW Countermeasures.

Research and Technology: Pulsed-Power Technology; CHAIR HERITAGE Program; Explosives Research; Metal-Matrix Composites; High-Energy Batteries; and Undersea Warheads.



Over NSWC White Oak



NSWC senior staff organization, effective 31 December 1987

Strategic Planning

NSWC has been developing a dynamic strategic planning process to assist in the development, application, acquisition, and training of its resources. The goal is to ensure the optimal use of NSWC's resources in order to satisfy the needs of the Surface Navy, now and in the future. In the first iteration of this process, NSWC chose to initiate a series of program and management thrusts. These thrusts—designed in 1985 and further refined in 1986 and 1987—focused internal efforts toward achieving an appropriate balance in the development of new capabilities for providing the systems the Navy needs over the next 10 to 20 years. These thrusts were to:

- Emphasize development and integration of Shipboard Electronic Warfare Systems;
- Increase efforts in the development and application of offensive and defensive low observables technology;
- Explore potential applications of artificial intelligence to naval systems;
- Expand directed energy technology efforts and examine weaponization options and requirements;

- Provide mission and weapons analyses to support the Navy's use of space systems;
- Build technology capabilities needed to develop advanced autonomous weapons;
- Assess the potential for initiating development of surface-launched ASW weapons;
- Enhance our capabilities to conduct single/multiple platform combat systems analysis and engineering;
- Establish a centralized capability for conducting naval warfare requirements analysis;
- Develop a strong technology base in information and systems sciences;
- Implement a systems design approach for all system and subsystem developments;
- Reduce the level of in-house manpower devoted to software maintenance;
- Upgrade or replace aging capital equipment and facilities;
- Eliminate administrative and procedural barriers to effective performance; and
- Emphasize the technology and development of insensitive munitions.



NSWC Dahlgren Administration Building

1987 Chronology of NSWC Events

1987 Chronology of NSWC Events

- Jan** NSWC employees raised \$180,000 during fund-raising drive for the 1987 Combined Federal Campaign. Dahlgren employees raised \$98,857, and White Oak employees raised \$81,473.92.
- Jan** VADM William F. McCauley, Commander, Naval Surface Forces Atlantic, visited Dahlgren. "You are doing a fine job here at NSWC" he said, "in supporting the fleet. I have all kinds of cruisers and destroyers at my disposal and I invite your engineers with their projects to test them out at sea." In a letter to NSWC, he wrote, "It was great to talk with so many of your professional people and see the important projects they are working on for our Surface Navy."
- 19 Jan** NSWC observed Martin Luther King, Jr., Birthday celebration, with speakers, films, posters.
- 22 Jan** NSWC Commander presented the 1986 Year End Report to NSWC Ft. Lauderdale staff and commended them "for another year of technical excellence."
- 27 Jan** CAPT Sheldon L. Margolis, USN, relieved CAPT Willard E. Siepel, USN, as Commander of the AEGIS Training Center, an NSWC tenant command.
- Feb** NSWC observed Black History Month, with speakers, films, flyers and articles in *On the Surface*.
- Feb** New chapters of Women in Science and Engineering (WISE) were organized at NSWC, sponsored by the Federal Women's Program Council members at the Center. White Oak's WISE organization chaired by Constance T. Jordan; Dahlgren's WISE organization chaired by Arlisa Flemmings. With over 100 charter members, WISE was established as a professional organization and separate entity from the EEO. Catherine Zachary was instrumental in getting the organization started at NSWC.
- 3 Feb** Ribbon-cutting marked opening of the Personnel Support Activity Detachment (PSD) and Scheduled Airlines Traffic Office (SATO) at Dahlgren. The PSD's 10-member staff provides pay, personnel and transportation services, and I.D. cards for military and civilian personnel.
- 6 Feb** NSWC observed National Prayer Breakfast at Dahlgren, with a guest speaker, retired CAPT Charles L. Keyser, USN, Chaplain Corps.
- 9 Feb** Claiborne D. Houghton, Jr., Director of Civilian Equal Opportunity Policy in the Office of the Deputy Assistant Secretary of Defense, spoke at NSWC in observance of Black History Month, whose theme was "The Afro-American and the Constitution: Colonial Times to the Present."
- 17 Feb** RADM Craig Dorman, USN, Director, ASW Program, SPAWAR (PD-80), visited NSWC White Oak and heard presentations on the Underwater Systems Department's ASW programs.
- 20 Feb** NSWC was designated Principal Support Laboratory for the TOMAHAWK Cruise Missile Weapon System and Design Agent and Software Support Activity for the AN/SWG-3 Weapon Control System Launch Control Group.

Mar NSWC lauded by Assistant Secretary of the Navy's Office of Logistics and Shipbuilding for its dramatic efforts to increase competition in FY86. The Navywide competition performance was 51.9 percent. However, NSWC's competition performance was 73.0 in FY86—achieved through Project BOSS (Buy Our Spares Smart) Program, PRICE FIGHTER Program value analysis, and completion of full screen breakouts.

Mar AEGIS Computer Center Annex began operation at NSWC White Oak, established to provide assistance to the AEGIS Weapons System Operational Readiness and Test Station (AWS ORTS).

6 Mar NSWC made the following senior management organizational changes:

- Leon J. Lysher, head of Underwater Systems Dept. retired (Dec 1986)
- Carlton W. Duke, Jr., appointed head of Combat Systems Department.
- Dr. Ira M. Blatstein, former head of Engineering Department, appointed NSWC Deputy Technical Director.
- Betty H. Gay, former NSWC Deputy Technical Director, appointed head of Underwater Systems Department.
- Paul Wessel, former head of Combat Systems Department, went on special training assignment under Executive Development.
- Dr. Thomas E. Clare, former head of the Strategic Systems Department, appointed head of Engineering Department.



AEGIS Computer Center Annex, which began operation at NSWC White Oak in March, provides assistance to the AEGIS Weapons System Operational Readiness and Test Station (AWS ORTS). Shown at the ribbon-cutting are (left to right): Philip R. Heron (N23A); Francis B. Fassnacht (N15 head); CAPT Raymond G. Landrum, USN (NSWC Deputy Commander); Lawrence L. Lehmann (N15); and Carlton W. Duke, Jr. (N Department Head).

13 Mar Carol Okin, Deputy Director, Washington Service Center, Office of Personnel Management, spoke to NSWC audiences in observance of Women's History Month.

20 Mar NSWC established Technology Base Council, headed by Bernard F. DeSavage. The Council acts as communication tool for technologists and recommends to the Technical Director Center policy regarding the formulation and implementation of NSWC's Tech Base Programs.

30 Mar NSWC Dahlgren held its annual Report to the Community, attended by 150 area business and government leaders who heard discussions on issues impacting the surrounding Dahlgren communities.

Apr NSWC was named Lead Laboratory for STANDARD Missile and directed to lead and coordinate technical efforts of Navy field activities and contractors involved in

the STANDARD Missile Program. NSWC also now provides leadership in the areas of safety, electro-magnetic environmental effects, and ordnance section engineering technical support. NSWC also was designated STANDARD Missile Technical Direction Agent for telemetry, and Design Agent for STANDARD Missile warheads and telemeters.

Apr Ribbon-cutting opened the Advanced Computer Systems Architectural Development Laboratory at NSWC White Oak, designed to develop technology independent systems engineering framework and the automated tools to support it.

1 Apr NSWC inaugurated the Scientists To Sea Program, which puts Center employees on board Navy ships to introduce them to actual conditions under which fleet personnel and their weapons systems operate. The Program, coordinated by NSWC's Fleet Interaction Office (Samuel Overman) and was first proposed by Alfred R. Hales (a former NSAP Science Adviser), and then formally urged by VADM William F. McCauley, USN, Commander, Naval Surface Force Atlantic, and wholeheartedly initiated by Capt Carl A. Anderson, NSWC Commander. More than 200 NSWC employees participated in the program in 1987.

15 Apr AEGIS Computer Center broke ground for a 22,300-square-foot addition at Dahlgren, to support the expanding fleet of AEGIS ships, with construction completion expected by July 1988.



Ribbon-cutting of the Advanced Computer Systems Architectural Development Laboratory (ACSAD) in April 1987. Shown (left to right) are Dr. Lemmuel L. Hill (NSWC Technical Director); Betty H. Gay (Head, Underwater Systems Dept.); and personnel who formulated the facility: Allen M. Jox (U01); Jose Casals (U33); Phillip Q. Hwang (U33); Steven Howell (U33); Teresa Park (U33); Craig Warsaw (U33); and Janis Bilmanis (U042).

16 Apr The late Vice Admiral Irving Terrill Duke, USN, a former Commander at the Naval Proving Ground ('51), was honored at NSWC Dahlgren when a recreational field was dedicated in his name during special ceremonies.

20 Apr Dahlgren children participated in ceremonies in observance of "The Month of the Military Child," held at the Pentagon, highlighted by the attendance of the wife of Secretary of Defense Caspar W. Weinberger.

1 May Harvey L. Styles, head of the Command Support Department, retired from government service.

2 May NSWC held an Open House at Dahlgren. Arthur D. Baker, Special Assistant to the Secretary of the Navy (Intelligence and Historical Matters), spoke. The theme for this year's Armed Forces Day salute was "Peace Through Strength."



NSWC Open House at Dahlgren, 2 May.

- 16 May** NSWC held an Open House at White Oak. Both open house events drew nearly 9,000 visitors.
- 22 May** As part of Spouse Appreciation Day, Karen Plackett, wife of the Chief Petty Officer of the Navy, William H. Plackett, USN, visited NSWC Dahlgren to look at quality-of-life issues (military activities, the Dahlgren School, Navy Exchange, Commissary, Child Care Center).
- 22 May** NSWC Dahlgren held a memorial service at the Dahlgren Chapel in honor of crewmen who lost their lives on USS *Stark*.
- 22 May** NSWC Commander presented a plaque to the Navy's Sailor of the Year, QMC Keith Williams, USN, during his visit when he accompanied Karen Plackett to NSWC Dahlgren.
- 29 May** Military Spouse Day was observed by NSWC, with a special luncheon held at Dahlgren. Honored guest Kathryn Decker, from the Navy Family Support Program Office (Wash., D.C.), quipped: "The Navy wife's job is the toughest in the Navy."
- Jun** NSWC was designated Lead Laboratory for the Technical Support Functions of the Surface Warfare Combat Systems Corrosion Control Program, headed by Dr. Chester Dacres, and sponsored by SEA-62D.
- 1-3 Jun** NSWC's Management Development Panel held a workshop at Leesburg, Va., (Xerox Training Center) to formulate policies and plans for the career development of the Center's supervisors and managers.
- 5 Jun** Alice Stratton, Deputy Assistant Secretary of Defense for Personnel and Family Matters, visited Dahlgren to look at quality-of-life issues and discuss the possibility of the closing of the Dahlgren School.
- 17 Jun** MS2 Elsa Black, USN, a records-keeper in the General Mess, was chosen as NSWC Sailor of the Year during ceremonies at Dahlgren.
- 19 Jun** NSWC held its third annual Technology Symposium, with its theme "Science at Sea," and keynoted by Nobel Prize-winning physicist Dr. John Bardeen (an NSWC alumnus). He spoke on "Reflections on Solid-State Physics and Technology Since World War II." Other special speakers included retired Admiral Wayne E. Meyer, former AEGIS Shipbuilding Manager at NAVSEA, who spoke on "Are We Missing Out on the Real Competition?"; E. Sonny Maynard, director of DOD Computer and Electronic Technology, who spoke on "Semiconductors: The Heart of Combat Electronics"; Frank Uhlig, Jr., editor of the *Naval War College Review*, speaking on "Technology and the Fighting Fleet"; RADM John B. Mooney, USN, Chief of Naval Research, speaking on "Technology Management"; and Dr. Lemmuel L. Hill, NSWC

Technical Director, who spoke on "Navy R&D Centers: A Full-Spectrum Approach."

- 19 Jun** Four NSWC scientists received special recognition at the NSWC Technology Symposium for their scientific/ technological contributions.: Dr. Ernst W. Schwiderski received the Science and Technology Excellence Award and presented a paper on "Modeling the Dynamic Sea Surface with Satellite Altimeter Measurements"; Richard Bardo received the Independent Research Excellence Award, and presented a paper on "Microscopic Theory of Explosives Structure and Sensitivity"; Milton H. Lackey, Jr., received the Independent Exploratory Development Award, and presented a paper on "Feasibility of a Closed-Loop Degaussing System for MCM and MHC Vessels"; and Robert G. Rihikka received the Independent Exploratory Development Award, and presented a paper on "Integrated Acoustic Target Tracker."

- 19 Jun** NSWC presented an Award of Excellence in Surface Warfare Technology to LCDR Thomas F. Olson, USN, an award given annually to the student from the Naval Postgraduate School, Monterey, Ca., in recognition of thesis excellence.

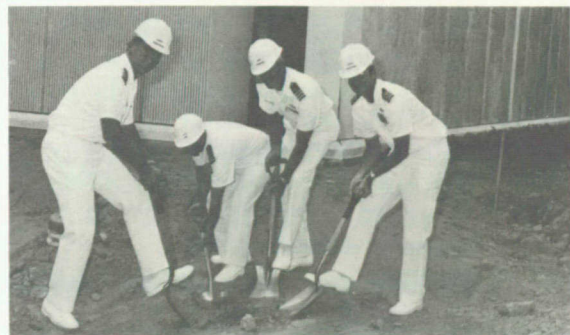
- 19 Jun** Dr. Ralph Decker Bennett, the first Technical Director of the Naval Ordnance Laboratory (1945-1954), was honored at NSWC in a special ceremony during the Technology Symposium in which the White Oak auditorium was dedicated in his name. The distinguished gentleman attended the ceremony—held in the Ralph Decker Bennett Auditorium—

and presented a speech entitled "Putting Science to Sea for World War II: The Development of the Modern Naval Ordnance Laboratory."



Distinguished speakers at the annual NSWC Technology Symposium held 19 June at NSWC White Oak were (left to right): Frank Uhlig (Naval War College); Dr. John Bardeen (twice Nobel Prize winner and White Oak alumnus); and Dr. Ralph Decker Bennett (former NOL Technical Director). At the conference, the White Oak auditorium was dedicated in Bennett's name.

- 23 Jun** Admiral Henri Cazaban from the French Navy visited NSWC Dahlgren for tours and talks.
- 24 Jun** The AEGIS Training Center—an NSWC tenant command—broke ground for a 31,200-square-foot addition to be constructed at Dahlgren, with completion expected in FY88.



Breaking ground for the AEGIS Training Center (ATC) addition on 24 June 1987 at Dahlgren are (left to right) CAPT Carl A. Anderson, USN (NSWC Commander); CAPT Sheldon L. Margolis, USN (ATC Commanding Officer); CAPT Edward B. Honzt, USN (OP-355); and CAPT George A. Huchting, USN (PMS-400F).

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- Jul** NSWC inaugurated the Model Installation Extension Program (MIEP), a program allowing Center managers and employees more flexibility in operating their programs.
 - Jul** RADM Ralph W. West, Jr., USN, Director of OPNAV's Pride, Professionalism, and Personal Excellence Div., OP-15, visited NSWC Dahlgren for talks and tours.
 - Jul** Flag officers visits to NSWC included: VADM William H. Rowden, Commander, Naval Sea Systems Command, to Dahlgren; RADM Robert H. Ailes, USN, Deputy Commander, Weapons and Combat Systems, NAVSEA, to Dahlgren; VADM Paul F. McCarthy, USN, Director of Research; Development and Acquisition (OP-98), to White Oak and Dahlgren; and RADM G. L. Jackson, USN, Director, Electronic Warfare (OP-956), to Dahlgren.
 - 2 Jul** VADM Glenwood Clark, USN, Commander, Space and Naval Warfare Systems Command, visited NSWC White Oak for talks and tours.
 - 5 Jul** Cynthia D. Hill became head of the Command Support Department.
 - 24 Jul** CAPT Kenneth D. Denbow, USN, relieved CAPT Donald G. Diaz, USN, as commanding officer of the Naval Space Surveillance System, a tenant command at NSWC Dahlgren.
 - 1 Aug** The NSWC Commander and Technical Director issued an All Hands statement outlining their vision for the Center's future. The "Vision Statement" was formulated in close consultation with department heads and other Center leaders and provides a framework within which NSWC's executives, managers, and supervisors should carry out their respective leadership responsibilities.
 - 1 Aug** The Naval Surface Weapons Center changed its name to the Naval Surface Warfare Center, by permission of the Chief of Naval Operations. The new name more properly aligns the Center with its mission as the principal R&D Center for Surface Warfare.
 - 10 Sep** RADM Byron E. Tobin, USN, the new Commander, Mine Warfare Command, Charleston, visited NSWC White Oak for an acquaintance tour and talks about mine R&D under way at the Center.
 - 11 Sep** NSWC conducted its annual Contract Symposium at Dahlgren, keynoted by Willis J. Willoughby, Director, Reliability, Maintainability, and Quality Assurance Office of ASN, and talks by Mervin F. Shreve, head, Electronics and Ordnance Systems Branch, Contracts and Pricing Div., in the Office of ASN; and Ray F. Carlin, Jr. of VITRO Corporation.
 - 18 Sep** RADM Robert H. Shumaker, USN, Director, Tactical Air, Surface, and Electronic Warfare Development Division (OP-982), spoke at NSWC Dahlgren in observance of National POW/MIA Recognition Day.
 - 18 Sep** NSWC released results of an employee survey conducted by a Navy Personnel R&D Center team, led by Alice Crawford. The survey dealt with the Center's level of organizational effectiveness and pointed up some employee and management concerns and problems

but also underscored some important strengths in terms of how effectively the Center is operating.

- 21 Sep** NSWC observed National Hispanic Heritage Week (13-19 September), including the welcoming of RADM Jesse J. Hernandez, Commandant, Navy District Washington, who spoke to White Oak and Dahlgren audiences on "Hispanics: A Proud History... Enhancing America's Future."
- 25 Sep** CAPT Albert L. DiMarcantonio, USNR, relieved CAPT David S. Griggs, USNR, as commanding officer of the Naval Reserve Space Command 0166 in a change of command ceremony held at Dahlgren.
- 1 Oct** Felipa C. Coleman was named Deputy Equal Employment Opportunity Officer at NSWC.
- 1 Oct** ADM Carlisle A. H. Trost, USN, Chief of Naval Operations, visited NSWC Dahlgren and toured its facilities and was briefed on the Center's technical programs. He also officiated at the dedication of the Naval Space Command's new Shepard/Glenn Naval Space Command-and-Control Center.
- 3 Oct** CDR Thomas C. Houghton, USNR, relieved CDR John H. Tisdale, USNR, as commanding officer of the White Oak Naval Reserve Detachment 206 in a change of command ceremony held at White Oak.
- 4 Oct** Jerry L. Reed was appointed Director of Navy Laboratories.
- 5 Oct** NSWC broke ground for the planned TOMAHAWK Weapon Systems Development Facility in special ceremonies at Dahlgren.



Jerry L. Reed, who was appointed Director of Navy Laboratories, effective 4 October 1987.

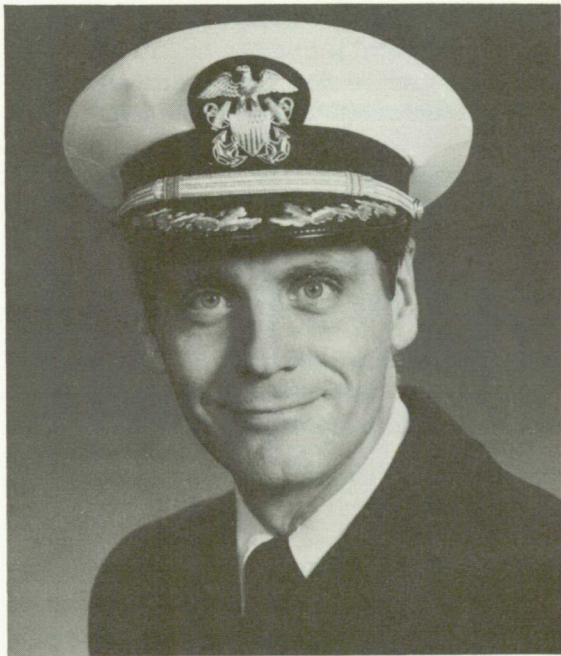
- 5-7 Oct** NSWC hosted its first Seminar War Game at White Oak, with the Arctic being chosen as the battle region. The games were led by Wayne Hopkins, with assistance by James O'Brasky (D25) and officials from the Center for Naval Warfare Studies at the Naval War College.
- 10 Oct** NSWC officials took part in the annual King George County Fall Festival, with various activities, including a parade.
- 13 Oct** NSWC celebrated the Navy's 212th Birthday with various employee activities and plenty of cake.
- 16 Oct** The Director of Navy Laboratories, Jerry L. Reed, visited NSWC White Oak for briefings and tours.
- 26 Oct** Congressman Herbert H. Bateman (R.Va.) kicked off the fundraiser for the Combined Federal Campaign at Dahlgren.

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- 31 Oct VADM Joseph Metcalf, III, USN, Deputy Chief of Naval Operations for Surface Warfare (OP-03), retired from the Navy. He was relieved by VADM John W. Nyquist, USN, now called Assistant Chief of Naval Operations for Surface Warfare (OP-03).
- 31 Oct NSWC officials participated in the SEACON 88 War Games at the Naval War College in Newport, R.I.
- 13 Nov NSWC inaugurated two comprehensive training programs called the *Supervisory Development Program* and the *Leadership and Management Development Program*, courses specially tailored by the Center's Management Development Panel to meet the needs of Center employees.
- 15-18 Dec The NSWC Commander and the NSWC Technical Director presented their 1987 Year End Report on the Center's accomplishments and major events, attended by all hands. The event included special awards given to employees who have distinguished themselves by outstanding work or service to the Center. The theme for the program was "Revolution at Sea Starts Here." Award recipients included: John A. Dahlgren Award—Donald E. Phillips, CDR William M. Hall, USN, and Dr. Jacques E. Goeller. Human Awareness Award—Dr. Joseph M. Augl and Walter S. Orsulak. Bernard Smith Award—James M. Dooley and William J. Lewis. Paul J. Martini Award—Angelo A. Floria, Susan G. Clancy, Leonard C. Carlson, and Rose G. Payne. The Admiral C. J. Rorie Award—LCDR R. W. White, USN. The Navy Superior Civilian Service Award went to Joseph E. Cuevas. The Navy Meritorious Civilian Service Award—Dr. Alexander G. Rozner, Donald H. George, Mark G. Hall, Dr. Allen Dan Parks, Thomas J. Greeley, Dr. Han S. Uhm, Richard Andrew Smith, Dr. Alfred M. Morrison, Alfred R. Hales, James S. O'Brasky, and Raymond M. Pollock, Jr.

NSWC Support Activities

Supply Department

by CDR T. A. Conner, SC, USN



CDR T. A. Conner, USN, Head, Supply Department (S).

Following are highlights of the Supply Department's activities during 1987:

Ney Award. The NSWC General Mess (S71) at Dahlgren competed for the 1987 Ney Award, an award based on stringent criteria that include inspection of food, management, administration, facilities, equipment and utensils, safety training and sanitation. S71 Branch has successfully completed two inspections, leading to the final judging in early 1988.

Contracting Symposium. We held a Symposium on Contracting on 11 September. Jointly sponsored by NSWC and the King George County Chamber of Commerce, the symposium focused on a number of major issues including current philosophy on evaluation of technical and cost proposals and emerging needs for contracted services at NSWC. About 125 people attended, representing large and small firms conducting business with the Center. The symposium proved to be very

effective in opening lines of communication with industry and sharing information on mutual problems.

Supply Operations Seminar. In February the Deputy for Supply Management (S06) office held a Supply Operations Seminar at White Oak and Dahlgren. In addition to S06 employees, representatives from Small Purchase and the Comptroller Department were on hand to answer questions about their respective areas. A myriad of topics were covered. This seminar helped increase the understanding of the supply process and it gave Supply Department a better understanding of the Center's issues and concerns.

Competition Advocacy Award. NSWC received the Competition Advocate Award for the period ending 30 September 1987. The award recognized the Center's aggressive effort to generate competitive specifications, challenge sole-source requests, improve communications with customers and widely disseminate buying requirements to suppliers. The Center completed 82 percent of its competitive base dollars (with a goal of 75 percent) and over 87 percent of all actions.

Significant Procurements. A major procurement effort was expended in Strategic Defense Initiative support in the area of charged-particle beam research by Sue Handy of the S22 Branch. This contract involved three years of conducting experiments on laser beam steering control for R42 branch. S22 supported the Strategic Systems Department in two areas: the first is PEP (telecommunications support) by awarding a \$3.5M contract to ICT for three years. The second was a \$3M contract with CTA for wind-tunnel support in upgrading the control system for the Hypervelocity Tunnel. James Bartha (S22) was the contract specialist for this work.

Karen Jackson of S22 awarded a contract for an electron beam gun for the Research and Technology Department (R41). The Supply Department had been working with a

R Department in upgrading its equipment buys in support of in-house research and experiments.

In the area of Small Business Innovative Research (SBIR), \$12M was funded for this program. During 1987 the S22 Branch awarded 45 phase one contracts (up to \$50K) and 12 phase two contracts (\$50-500K) for all areas of research at the Center.

During 1987 **Pam Schmidtke** of S205 provided contracting support for the following actions:

(1) development of the AN/SQQ-89(v) Surface Ship ASW Combat System. The contract calls for performing a system test of the SQQ-89(v)4 at the ASW Engineering Development Site Facility in Syracuse, NY. The system being developed is to be installed on the USS *Arleigh Burke*-Class (DDG-51) AEGIS guided-missile destroyers.

(2) ASW system testing of the AN/SQQ-89(v)3 Surface Combat for the CG-56 and to initiate testing of the AN/SQQ-89(v)4 ASW Combat System, including the integration of On-Board Training (OBT) and improved Special Test Equipment (STE).

(3) Complete integration and testing of production AN/SQQ-89(v) Surface Ship ASW Combat Systems at the Production Test Site (PTS) at the GE Electronic Park Facility. The AN/SQQ-89(v) ASW Combat System contains an integrated assembly consisting of a hull-mounted sonar, towed-array sonar, a sonobuoy signal processor, a data processing system, and an ASW Control System (ASWCS). This assembly is needed to effectively detect, classify, and track enemy submarines. There are eight shipsets and five system configurations to be tested.

During 1987, S21 began the competitive acquisition process for the Lightweight Early-Warning Detection Device (LEWDD). There is both a shipboard and ground-based sensor

tasked to provide Low-Altitude Air Defense (LAAD) personnel with an early-warning detection device to alert LAAD gunners and maximize the effectiveness of their surface-to-air weapons.

During 1987, NSWC awarded to COMPTek, a small business in Buffalo, NY, a competitive contract of \$6.2M for 229 AN/ULQ-16 computer systems and spare kits. The AN/ULQ-16 system originated as an NSAP requirement for a pulse analyzer capability. Several sole-source contracts were awarded during the developmental phase to a company other than COMPTek.

A \$22,610-million contract was awarded to Zenith Data Systems of Vienna, VA, for the acquisition of AT class, 16-bit Tempest and Non-Tempest Workstation Systems. It provides for acquisition of up to 2,500 LSEW systems during the initial three years (a base year plus two option years) of the contract and provides for an additional two option years for maintenance. This acquisition was conducted on behalf of the Navy Laboratories Technical Office for ADP and Communications Systems (NALTOACS). The contract is available for use by all nine Navy R&D laboratories and for the Naval Air Test Center at Patuxent, the Pacific Missile Test Center at Pt. Mugu, and the Naval Air Engineering Center at Lakehurst. **John Silcox** and **Susan Harding** were the contract specialists for this acquisition.

Ten contracts valued at over \$5.9M were awarded in 1987 for equipment to support expansion of the AEGIS Computer Center, AEGIS Training Center and the AEGIS Combat Systems Center. Of these ten actions, nine, valued at nearly \$6M, had to be conducted without full and open competition in order to ensure compatibility with equipment currently in the fleet. Materials acquired included disk drives, workstations, VAX computers, array processors and upgraded to existing Gould computers. This effort involved the dedicated talents of several contract specialists, including **John Silcox**, **Betty Kniceley**, **Lee White**, **Linda Clifton**, **Jean Godfrey**, and **Vivian Campbell**.

In September an ID/IQ contract was awarded to RCA Moorestown, providing for AEGIS Backfit System Engineering tasks. The award ceiling amount of this contract was \$23M for a three-year period. The COTR was **R. E. Lutman** (NO56), and the contract negotiator was **Pat Canciglia** (S12).

In September, a CPFF/LOE contract was awarded to Advance, Inc, an 8a firm, to provide computer operator support to the ACC and SGS lab. The contract amount for five years was \$4.1M. The effort was transitioned from an incumbent 8a vendor to Advance. The COTRs were **Wayne Hawker** (N23) and **John O'Brien** (K50), with contract negotiation performed by **Barbara Glover** (S12).

In July an ID/IQ contract was competitively awarded to ORI, Inc., Rockville, MD, to provide support to the Vertical Launching System. The total contract ceiling was \$7.9M. The COTR was **Kenneth Novell** (G73) and the contract negotiator was **Nancy Ballenger** (S12).

In July, a CPFF/LOE contract was competitively awarded to Advance Technology, Inc., to provide technical engineering support at Wallops Island. The contract amount was for \$3.6M for a period of three years. The COTR for this effort was **Larry Kutty** (N30), and the contract negotiation was performed by **Carol Cruickshank** (S12).

In June and July two 8a contracts were awarded for engineering and technical services to support the chemical warfare and ship survivability program at NSWC. Daedalean, Inc., was awarded an ID/IQ contract for \$6.2M to provide reliability/survivability studies of equipment/systems in support of chemical warfare. Integrated Systems Analyst was

awarded an ID/IQ contract for \$13.7M to determine and develop personnel training needs for new shipboard equipment and systems. The COTR for both contracts was **Charles Hill** (H30). The contract negotiators were **Carol Cruickshank** and **Barbara Glover** (S12).

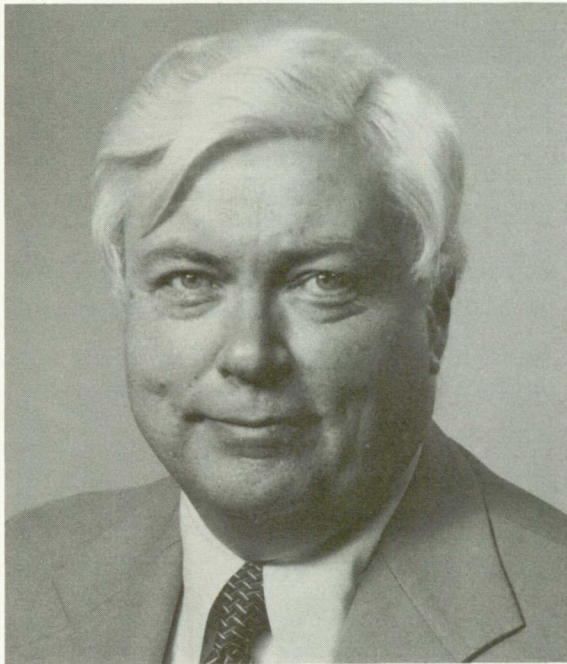
In July, NSWC awarded a contract to RCA Moorestown for all labor and materials to design, install, and deliver a fully tested and operational training configuration to support the AEGIS Cruiser Baseline 3 and 4 at the AEGIS Education Center. The award amount included estimated cost of \$5.5M, base fee \$122.4K, and maximum award fee \$550.5K for a total estimated cost plus award fee of \$6.2M. This was the first competitive award for activation of an AEGIS Training Facility. The COTR for this contract was **Bobby Layman** (N04). **Judith Schmidt** (S122) handled the contract administration.

In early January 1988, NSWC awarded a contract to Advanced Technology, Inc., Reston, VA, for professional engineering, technical, operational, and administrative services in support of the AEGIS Education Center (AEC). The contract, which covers work in FY88 and four optional years of continuing effort, was a competitive award for a cost plus fixed fee of \$495,478 for the first nine-month period, \$3.6M for all years. This is the first major contract in support of on-going operations at the AEC. The COTR for the contract was **Luke Miller** (Technical Director, AEC); the contract specialist was **Judith Schmidt** (S122).

Admiral Zumwalt Award Competition. The NSWC Bachelor Enlisted and Bachelor Officer Quarters competed as the SPAWAR nominee for the 1987 Admiral Zumwalt Award, an award based on the ability to operate and maintain an attractive, well-managed berthing facility.

Comptroller Department

by H. D. Shields



H. D. Shields, Head, Comptroller Department (M).

The Comptroller Department (M) is responsible for establishing and maintaining an integrated financial management system for the Center. Its duties revolve around developing procedures and policies to promote economy and efficiency in the use of NSWC resources.

M Department experienced greater involvement in the Center's financial resource allocation processes in 1987. As a result, the Comptroller's traditional role of paymaster for the Center has been expanded. This expansion required new capabilities and expertise in our department. The year 1987 was one in which the Comptroller Department began acquiring the skills the present environment demands. Business data processing was augmented with new leadership and personnel equipped to confront contemporary challenges. The stage was set for new system tools that would provide both the Comptroller and the Center with means adequate to accomplish the task of converting to

STAFS. The task of training department personnel for the demands of the times was begun as were plans put in place for further upgrading of the department's base of financial professional workers.

A number of 1987 actions are worthy of note. During 1987 our Financial Information Systems Division worked with our Accounting and Disbursing Division to enhance the initial version of the *Invoice Tracking System* to interface with the *Dealer Payment System* and provide new reports required to monitor *Prompt Payment Performance*. The revised system resulted in reduced interest payments and the elimination of duplicate entry of invoice data, while providing aging reports to the Comptroller and Supply Departments. We began producing various functional area and management reports that would provide more detailed statistical aging data designed to further reduce interest payments.

Also in 1987 we implemented an *Interim Travel System*, which combined all travel, disbursing and accounting functional duties under one organization. This means that the Travel Claim Section (M31) now processes all disbursing and accounting transactions on employee travel orders. This new system was part of the preparation for converting to the Standard Automated Financial System (STAFS).

We completed our first major Commercial Activities (CA) study, that of Supply Operations. It ended in conversion to contractor performance of Supply operations functions. However, the conversion was accomplished without adverse impact to NSWC employees.

Public Works Department

by CDR W. M. Hall, USN



CDR W. M. Hall, USN, Head, Public Works Department (W).

The Public Works Department is responsible for the construction and maintenance of facilities and utilities for NSWC and its tenant activities. During 1987, the Public Works Department has provided strong leadership to key areas of change within NSWC.

Noteworthy 1987 accomplishments include:

- The successful initiation of a "sell and replace action" for NSWC Ft. Lauderdale.
- The successful initiation of an "802" Family Housing Project for NSWC Dahlgren.
- The successful negotiation of an upgrade to the Base Telephone System at NSWC Dahlgren at no cost to the government.

- The successful negotiation resulting in a local entrepreneur bringing cable TV service to NSWC Dahlgren at no cost to the government.
- CNO approval for execution of a seven-year plan to manage and remove relocatables at Dahlgren.

In addition, the Department has substantially increased productivity as evidenced by the following:

- Tripling of the contract execution rate from FY87 to FY87.
- Producing the best Commercial Activities (CA) Performance Work Statement the CHESDIV has reviewed to date.
- Naming of the Public Works Department as best Field OICC/Roicc in the August 1987 Procurement Management Review by CHESDIV.
- Executing an additional \$4M over target in RPMA for FY87.

In addition to the above, the Public Works Department has made substantial studies in automation. This has included the bringing on line of a substantial number of personal computers and data bases. The personal computers will be networked and databases will be shared in the near future through the introduction of an innovative network. This is a state-of-the-art effort that will yield benefits both for the Public Works Department and NSWC.

The Inter-Service Support Agreement Program was developed to a higher level of effort to negotiate and establish a business relationship with all of NSWC's tenant activities.

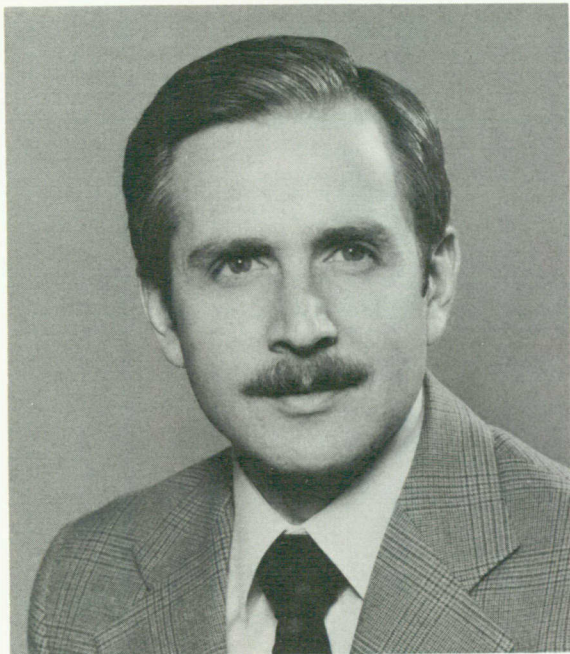
The addition or contracting for the addition of several facilities to NSWC are also important to note. These facilities contracts are as follows:

- Computer-Aided Design & Drafting (CADD) Facility.
- AEGIS Education Center construction contract.
- Personnel Support Facilities (BEQ, BOQ, EDF) construction contract.
- TOMAHAWK Facility construction contract.
- Arts & Crafts Facility construction contract.

This effort is noteworthy because it emphasizes NSWC's success in competing for the limited money available in this area and the ability of the Department to meet the needs of NSWC and its tenants for new facilities.

Personnel Management Department

by Thomas E. Evans



Thomas E. Evans, Head, Personnel Management Department (P).

Several major programs were undertaken in 1987 that benefitted both Center management and employees and for which the Personnel Management Department had significant responsibility.

Flexitour. NSWC implemented *Flexitour* as its prime employee work schedule on a two-year trial basis. This work schedule was selected because it is suitable for our mission, allows managers to effectively plan and schedule work, and provides additional flexibilities for managers and employees. Benefits anticipated from *Flexitour* include a saving in overtime costs, greater productivity, and a better quality of work life for employees.

Employee Assistance Program. During 1987 the Center expanded its Employee Assistance Program (EAP), through contract, to a "broad brush" program, providing employee counseling and referral assistance for essentially any type problem an employee is likely to encounter. The

result of this program expansion has been an increased employee confidence and use of the program counseling service. The long-term goal of this program are to reduce absenteeism, tardiness, accidents, and attrition, and to increase employee productivity and morale.

College Recruitment Program. NSWC had a very successful recruiting year in 1987, with 125 new scientist and engineer (S&E) hires. The acceptance rate of all entry-level S&E offers made this year reached 60 percent, much higher than our historical average (33 percent). The considerable investment made this year in revamping the recruiting program paid off. Strong emphasis was placed on upgrading the Center's professional recruiting literature. Highly motivated senior-level S&Es were selected to recruit at the top 20 schools from which the Center hired over 50 percent of its entry-level S&Es over a three-year period (FY84-86).

College students from 200 schools throughout the United States applied for positions at NSWC. The largest number of applicants continue to come from the University of Maryland and the Virginia Polytechnic Institute and State University. Other schools where the Center concentrated its recruiting efforts included the University of Puerto Rico (Mayaguez), Atlanta University Center, Georgia Institute of Technology, North Carolina State University, University of Virginia, Mary Washington College, University of Illinois, City College of New York, and Pennsylvania State University.

Since NSWC is committed to providing employment opportunities for the nation's underrepresented groups, recruiting efforts have focused on many schools that have large numbers of minority students. For example, active recruiting at the University of Puerto Rico resulted in employee offers to seven students, with four acceptances. The Center also hired two Hispanic students and two Black students as administrative co-ops in the Personnel Management, Comptroller, and Supply Departments. The Center's Cooperative

Education Program, with 155 co-ops, is ranked among the largest in the Navy. Forty new co-ops were hired this year, and will alternate periods of work with study throughout their college years. Upon graduation, they will be eligible for permanent positions at NSWC. Historically, nearly 70 percent of co-ops who graduate accept permanent employment with us. Forty graduating co-ops received permanent employment in 1987.

Civilian Health Promotion Program. Also during 1987 NSWC piloted a civilian health promotion project at White Oak, called the Wellness Program. Sponsored by the Naval Military Personnel Command and the Navy Office of Civilian Personnel Management, the project was designed and conducted over a 12-month period by an OCPM health promotion specialist, with an evaluation contract awarded to the Institute for Resource Development (IRD). The goals were to stimulate positive changes in employee health knowledge, attitudes and behaviors, to reduce health risks among project participants, thereby increasing organizational productivity, and to develop a model health promotion program at White Oak that could be

exported to Dahlgren and throughout the Department of the Navy. White Oak was used as a model for this pilot project. The objectives of the program were to give employees the information they needed to make better health care decisions, the skills they need to modify behavior, and the motivation to take responsibility for their own health. Many employees took part in this program. A number of benefits were realized by the program, including: (1) positive changes in health-related knowledge and practices; (2) identification of previously unknown medical problems; (3) increased knowledge of medical care resources and alternatives; and (4) employee recognition of NSWC's commitment to them and their health. Preliminary studies indicate a high level of employee and manager acceptance of and satisfaction with the pilot project. Surveys show increases have occurred in employee knowledge of potential health risks as well as the benefits of proper exercise and diet. Employees also cited that the program showed management's concern for people and a positive emphasis on physical fitness. This can be expected to result in a higher level of employee health, satisfaction, retention, and productivity.

Command Support Department

by Cynthia D. Hill



Cynthia D. Hill, Head, Command Support Department (X).

The past year has been one of renewal and rededication. Since my appointment as head of the Command Support Department (X), we've embarked on a comprehensive overhaul of all of our divisions. Each division has been caused to reevaluate its mission and purpose and to seek new ways to improve services. Aggressive personnel management has improved both the quality and responsiveness of managers and staffs. Organizational structures have been simplified and lines of communication and responsibility clarified. We've eliminated unnecessary duplications to a large degree. The organizational philosophy of "one center, one policy" was used successfully in 1987 to take the best products from each site and transfer their benefits to the other sites.

A major thrust in 1987 has been in the area of management training and improvement. Good management practices, open communications, standards of conduct, and equal treatment for

all employees have become the goals of X Department managers. A new pride in a well-organized, efficient, and effective department is rising up from personnel at all levels.

A forward-leaning attitude has been adapted department wide. Managers and staff continually seek new and better ways to do their assigned work. In addition, new missions, such as the Auxiliary Security Force, are eagerly accepted by department staff. Such new missions not only provide variety to the personnel, they better support the Center and ensure the department's good standing.

There is still much to be done. Very hard decisions still remain to be made. However, our goals are clear and the pride is back.

Computing & Information Systems

by Joseph H. Francis



Joseph H. Francis, Head, Computer & Information Systems Division (K30).

As I reflect back on 1987, I realize that it was a time of great change for the Computing & Information Systems Division (K30). Early in the year, the senior staff held a retreat, which was to have long-term influence on our organization and work. Nominally, the major topic was how to evolve the PEP office automation system to a next-generation system that integrated personal computers and offered greater functionality. The outcome was more far-reaching because it became apparent that the scope of the evolution should encompass all of the division's computing, information systems, and telecommunications programs. In addition, because people need desktop access to the business computers as well as the scientific computers, we envisioned an expanded role for the division in the area of business systems.

At that time, we were providing data communications support for the STAFS Program and maintaining liaison with the IRM Office, but

that was the extent of our involvement in business systems development. Following the retreat, that changed. A team of senior computer scientists was formed to look at options for developing an integrated business system. We reported to the NSWC Board of Directors on that effort in May 1987, titling it Conceptual Systems Architecture for Integrated Centerwide Information Systems. The option for a partially distributed system was selected. At its core is a computer system, which hosts Center applications and to which the mandated business systems (STAFS, for instance) and the departmental business systems are integrated.

In the Fall, the senior staff spent much of September and October developing a ten-year strategic plan for Cycle III of the Center's planning process. The timing was excellent for formalizing our new thrusts in desk-top automation and business systems development, as well as moving into the next generation of scientific computing by planning for acquisition of supercomputers. Tying together all these systems, literally, will be a much-enhanced telecommunications system. We made plans to deploy computer-to-computer networks throughout the Center to achieve the connectivity needed for integration of scientific, business, and desk-top systems. The strategy called for changes in organization and skills mix within the division. What are now Product Lines will become Strategic Support Units because Computing and Information Systems has become a planning Sector. A new Strategic Support Unit, Business Information Systems, was added to provide a focus for the business thrust. Computer Systems Integration was not carried forward as a Strategic Support Unit, but will continue as a line function with a branch devoted to supplying such support to all the systems in the division.

While all these forward-looking events were going on, the project leaders, scientists, engineers, technicians, specialists, and clerical staff were doing their usual great job in operating, maintaining, and enhancing our present services. I would like to address each of

our current product lines and record their major accomplishments in 1987.

Scientific & Engineering Computing Systems

To meet the steadily increasing customer demand for both classified and unclassified computing, we enhanced the Center's suite of large-scale computers. By exercising options in a contract with the Control Data Corporation (CDC) let in 1983, the two CDC 170/865 systems at the Dahlgren site were upgraded to CDC 170/875 systems, a CDC 180/860A system was installed at the White Oak site to replace a CDC 170/720, and the CDC 170/760 was released at the Dahlgren site. These actions approximately doubled the computing capacity. In addition, the 180/860A will support a virtual memory operating system, making it possible to execute very large address-space computing problems; a similar capability is planned for the Dahlgren site in 1988 when we will install a CDC 990 system. These systems provide service to all Center scientific and engineering personnel, but the largest customer is the SLBM program.

A second major activity was a study to determine large-scale computing needs at the Center during the 1990s. The study showed substantial requirements for next-generation supercomputer systems to support SLBM, STANDARD Missile, and Space and Geodesy work, among others. We will initiate an acquisition program in 1988 to satisfy these requirements through the year 2000.

Office Automation/Management Information Systems

We continued to deploy and enhance the Productivity Enhancement Program, PEP. This office automation system is now available to all Center line managers to the branch level as well as all offices of the Comptroller, Personnel, Supply, Administrative Support, and Public Works Departments. We added 500 new users for a total of 1500. Accreditation of the system to handle Level II (business sensitive and

Privacy Act) material was achieved. A significant enhancement was software to allow file transfer between PEP and personal computers; this is a first step in integrating the Center's large suite of personal computers with other computer systems.

Looking forward to the next generation of desk-top automation, we initiated the NSWC Office Automation (NOA) Program. NOA will provide software, interfaces, and networking so that personal computers and work stations can be fully integrated with the Center's many business and scientific computing systems. NOA will provide functionality beyond that offered by PEP in the areas of graphics, access to Center databases, applications sharing, and scientific applications. Movement of customers from PEP to NOA will be evolutionary.

Telecommunications

The Center-Wide Area Network (CWAN), a terminal to host computer network operating on broadband cable plants at both sites, saw a substantial increase in use; we made 500 new connections for a total of 2,500. In addition, we completed test and evaluation of improved network interface units, and made a prototype deployment. These units, known as System 2000, are more user-friendly because of their call directory capability; also, they use the network more efficiently, thus reducing traffic density.

The cable plant used by CWAN does not reach all of the Center's buildings, so some connections have to be accomplished with less reliable, lower-speed telephone company circuits. At Dahlgren, we started a major program to extend the cable plant to 55 additional buildings. A multimedia backbone cable, with coaxial, fiber optic, and twisted pair conductors, is planned for installation beginning in 1988. We also completed plans for reaching the remaining buildings at White Oak.

We replaced the multiplexers that terminate the high-speed T-1 digital link between sites

with improved equipment which permits automatic reconfiguration of link channels and provides capacity for additional T-1 links. The installation increases the reliability of communications between sites.

We completed a feasibility study and requirements analysis for Video Teleconferencing (VTC) at NSWC and briefed the study to top management. A decision on program initiation will be made during 1988.

Computer Systems Integration

We reached several milestones in the continuing effort to integrate the Center's mainframe, mini-, and personal computers by networking them not only with each other but to other computer systems in the DOD community. We extended the Center's host-to-host network, known as NSWC-NET, to Building 218 at Dahlgren, allowing PEP nodes to be deployed there. We developed personal computer standards to guide acquisitions so these systems can interoperate with Center applications and networks. We evaluated personal computer sub-networks, commonly referred to as Local Area Networks, for capability to operate in the NSWC networking environment. We initiated acquisitions and development efforts to improve

the reliability of the Gateway computer to the Defense Data Network, NSWC's communications link to other DOD systems.

ADP Policy

This product line comprises administration of policies for ADP Security and ADP Acquisition for all the computer and telecommunication resources in the Center. Because of the increase in the number of these systems, we took several steps to streamline procedures without sacrificing either the effectiveness of the policies or the regulatory requirements. To address the large number of systems, we initiated a continuing series of ADP Security Awareness Training seminars to help users and administrators understand how to protect computer data. We streamline the system accreditation procedures so there is minimal paperwork for small systems such as personal computers. We investigated how to streamline the acquisition of ADP hardware and software costing less than \$1,000 so that buying a software package for your personal computer, for instance, will not be a major undertaking. You could say that the major theme in this product line was to execute our own paperwork reduction program while maintaining effectiveness.

NSWC Command Perspective



NSWC Command Perspective

by CAPT Carl A. Anderson, USN



CAPT Carl A. Anderson, USN, NSWC Commander.

In 1987 we focused our strategic planning to provide NSWC with realistic goals and objectives that will carry us into the 21st Century. In response to fleet requirements and the CNO's priorities, our top management began restructuring NSWC's technical programs to maintain a work balance of 60 percent for systems development, 20 percent for exploratory development, and 20 percent for in-service engineering. We explored the right combination of talent, facilities, and programs necessary to give the Navy the required resources to operate and protect our seas. Our strategic planning helped increase the relevance of our operations tenfold. Not only is NSWC the leader in strategic planning among the R&D laboratory community, the Director of Navy Laboratories is using our strategic planning model as the standard for the other centers.

The CNO stated last year that Antisubmarine Warfare (ASW) had become his number-one priority. As the primary R&D laboratory in the area of surface ship weapons, NSWC has been

heavily involved in ASW for some time. As the threat becomes increasingly more quiet, surface ships need to play a greater role in protecting our high-value assets during battle group operations. In addition, to fight the ASW battle properly, we realized we needed to integrate data from electronic warfare (EW) and antiair warfare (AAW) with ASW. Our being named the life-cycle support facility for the Mk 116 Mod 7 ASW Fire Control System should familiarize us with the weapons, sensors, and fire control equipment, helping us facilitate the integration of the EW and the AAW.

Warfare Systems Architecture and Engineering (WSA&E) continued to be a priority for NSWC in 1987. WSA&E orchestrates the various components of the fleet and examines force warfare *horizontally* rather than *vertically*. Traditionally, we approached warfare through its components in a vertical mode. For example, we looked at ASW vertically from the platform all the way up to the command and control. The same is true for mine warfare and electronic warfare. In the WSA&E perspective, the entire carrier force and its affiliated shore activities work horizontally. Now all of these programs must be integrated in new ways to achieve battle management. This requires, wherever possible, planning beforehand how all the components will be compatible and able to communicate with each other. NSWC is helping to shape this exciting wave of the future.

When the unfortunate *Stark* incident occurred last May, NSWC's experts became intimately involved as part of the investigative team that studied the aftermath of the ship's missile attack, particularly in the area of EW. As a result of their findings, we initiated some important changes to some of the ship's systems as well as changes in methodology for gun operation and anticruise missile warfare. Moreover, we established a new NSWC program last year called Rapid Air Defense System (RAIDS), which horizontally integrates EW devices and decoy systems (all of which were invented at NSWC). This defensive system

enables our fighting ships to “see” in all directions simultaneously.

In 1987 we initiated action to change the name of our facility from the Naval Surface Weapons Center to the Naval Surface Warfare Center. Our new name, approved by the Chief of Naval Operations, became effective 1 August. It more correctly identifies our primary Navy mission: surface warfare and the application of R&D to surface warfare.

In one of our most significant events of 1987, we established four “resource boards,” each comprised of senior executives and representatives of other management levels. Charged with bringing a corporate perspective to the Centerwide management of resources, the boards are called the Finance and Business Systems Board; the Facility, Logistics, and Equipment Board; the Human Resources Board; and the Programmatic Board. Each plays a vital role in the effective implementation of our plans at all levels. Members establish or recommend Center policies, strategies, and objectives for resource management; provide guidance for allocating resources; and review progress in the use of resources to meet NSWC objectives. Although in operation only a short time, the boards already are playing an integral and influential part in the Center’s decision-making process.

Another significant event begun in 1987 was our C-D/Supervisors Meeting, a quarterly gathering of line managers and supervisors at Dahlgren and White Oak, where Dr. Hill and I discuss topics of major interest to employees. During this open forum, we take impromptu questions, address problems/issues, and discuss policy and procedures. These well-attended assemblies offer employees an opportunity to voice concerns and receive on-the-spot responses. The meetings have enhanced our two-way communication in a most positive way.

In 1987 we were plagued by environmental issues, some of which could materially affect our future technical or test operations. One

involves deep-water explosive testing in the Chesapeake Bay and the resultant fish kills, causing us to rethink our testing methods. Another issue concerns the increasing deer population at White Oak and the need to find a way to thin out the herd that would be consistent with environmental objectives. A third issue involves complaints from Dahlgren residents about the noise from test firings at our Gun Range, especially those emanating from our 16-inch guns. A fourth concern deals with our electromagnetic pulse (EMP) testing at the EMPRESS I facility, a subject that has received national attention.

Each of these issues has received serious and careful attention by our people. We’ve held extensive talks with concerned environmentalists, experts, and the press. These are not “we” and “they” issues. Defense and the Environment are not mutually exclusive; they can be compatible. We were still debating many of these issues as 1987 came to a close, and our deliberations shall continue. NSWC has traditionally shown a strong interest in conducting its testing in such a way as to preserve the environment for all of us. In all instances, we shall continue to look for creative alternatives. We want our testing to be consistent with good environmental practices—ones we can all live with—and still meet our critical Navy mission. That’s the bottom line. We will continue to work with special-interest groups and others to resolve these issues.

Under the Commercial Activities (CA) program, we unfortunately lost our bid to retain the Supply function at NSWC. The action was significant because it affected a considerable number of employees. Our people were very sensitive to the needs of the affected employees, conducting skills conversions and doing cross-hiring whenever possible. The CA conversion of the supply function itself was executed in a highly professional manner. The CA process has caused us to be more critical about the way we conduct business, prompting us to streamline our other operations so that they are performed more efficiently. We are now better prepared

than ever to conduct our CA studies on other Center functions—the next one being the transportation function.

We began a number of initiatives in 1987 to keep pace with the growing pains at Dahlgren and to enhance the quality of worklife there. For example, the dramatic increase in the number of military personnel and their dependents resulted in a severe housing shortage on base and a need for additional base services. So we began working with local officials to encourage construction of affordable housing in the area of our military personnel. We also embarked on a \$6M program to upgrade our base housing (about 150 units) at Dahlgren. Although well maintained by our Public Works staff, many of these houses, built in the '40s have been long overdue for modernization. We established a Spouse Referral Agency and opened a new child care center. We developed a Chief's Association and a First Class Association. In the recreation area, we installed a half-mile track and an exercise facility, and we also extended the gymnasium hours—all of these things to enhance the quality of life for our people.

In some areas at Dahlgren our employees are still working in leased buildings outside the gate. We were quite successful last year in terminating some of these lease agreements and relocating some of our people on our property. For years, other Dahlgren employees have occupied "temporary" trailers on base because of the shortage of modern work space. To alleviate this intolerable situation, in 1987 we developed a comprehensive five-year construction plan, which includes provisions for relocating these "displaced" employees.

A controversial subject we dealt with last year was the potential closing of the Dahlgren School for military dependents (grades K-8). DOD looked at a number of its Title VI schools to determine which ones might be good candidates for closure. We refused to take the issue sitting down. We fought it all the way, conducting extensive studies and conferences among Navy

and DOD officials. Study findings clearly indicated that the school should remain open.

To summarize, all of the things of which I spoke—our strategic and tactical planning, our R&D contributions to the fleet, WSA&E, the resource boards, our concern for environmental issues, our improved worklife conditions—are all important, interrelated issues because they unify our people to continue being productive on the cutting edge of technology. We need to maintain a climate at NSWC where people can work better, happier, and with greater enthusiasm, initiative, and resolve to develop products for the fleet, put ordnance on target, and achieve victory at sea.

I am very upbeat about the health of NSWC. The year 1987 was a significant one: we reacted to crisis and won praise, overcame the difficulty of the imposed hiring freeze, developed a more stable workforce than we had in 1986, enhanced our mediums of communication through the Center, and provided more support to our tenant and civilian activities across the board. Our funding profiles remain stable and our employee morale continues to rise.

If you want to see an example of enthusiasm, talk to some of our scientists and engineers who have just returned from our ships as part of the Scientists to Sea Program. Last year, over 175 employees participated, many returning with a better perspective on their work and a renewed commitment to excellence. Another reason our employees are so committed is that many of them came from our co-op program. While still in college, they began to grow into their careers at NSWC. Their expertise and length of service are a great asset. We need to adopt this same course for our support personnel. For a long time we've been grappling with the "forever" question: the correct balance between technical and support. The fact is, the technical and support people must march together, because without the support forces you cannot put a gun in the field.

When we look at the horizon ahead, should we be afraid of change? No. As a matter of fact,

we are the experts in change. Take a group of scientists and engineers in one area and ask them how many have been working on the same project for the last ten years. I bet few hands would go up. That is because NSWC's tradition of innovation continually pushes us forward. This Center has been, is, and will be a role model for the modern R&D laboratory.

Corporate Issues and Studies

Corporate Issues and Studies

by M. John Tino



M. John Tino, NSWC Associate Technical Director.

The Center ended 1986 with concern and anticipation. Concerns were keyed to our controls for financial management: Manage to Payroll (MTP); carryover; the 70-30 rule; and prompt payment. We anticipated the advantage to the Center for Cycle III of our strategic planning and for our commitment to support SPAWAR in making force level system architecture and engineering work.

We believed we had a realistic allocation of the MTP to each department, and a tool to monitor MTP use was in place. Nevertheless, it added another dimension to the management model used by our department heads to match resources and technical tasks. It just wasn't clear at the end of the first quarter of FY87 if the new control had created a negative factor in our management equation. It was clear that each manager was taking this new control seriously and was being very careful with resource allocations.

Carryover and the 70-30 rule worked somewhat as a system, and by 1987 it was clear our program managers had adapted to both processes. We were working closely with our sponsors so that funding documents were received with maximum flexibility to distribute our funds between in-house and contracts. "Direct-site" to contractors was an efficient parameter in the program manager's model to remain within these controls. We had met our 1986 carryover goal. Our 1987 goal was significantly reduced, but we believed it was achievable.

Business reviews had continued through 1986, and they were making a difference. Internal review and control programs were becoming solid. The Commercial Activities (CA) Program was under new management and better control of the process was being achieved. It did appear that the Supply Operations CA was going to a contractor. This conversion to the contractor was ahead in 1987. Prompt payment continued to be a thorn. Management attention between the Supply and Comptroller Departments had decreased the interest paid for late payment of bills. However, many factors went into this equation, including the technical person completing receipt verification in an accurate and timely way. The process remained labor intensive and staffing of these comptroller positions was difficult and continuing. The automated processes—like STAFS (Standard Automated Financial System)—appeared to be the ultimate answer. The Center had formed a new and larger program management team to implement STAFS. It was helping, but we were still at the mercy of the Navy's STAFS Program delivering the verified software for the system. Concern certainly remained as we entered 1987.

The key changes in the Cycle III planning process were to divide planning into strategic and tactical, and to utilize a *Center Needs Study* to initiate strategic planning. Strategic planning was to produce a top-level Center vector. Tactical planning would produce the detailed resource allocation.

SPAWAR had developed processes for conducting Battle Force System Engineering in 1986. While some aspects were successful, they continued to work to organize and develop a means for doing force architecture. By the end of 1986, it had become clear that a marriage between the Centers and SPAWAR was necessary. A link, via the Director of Navy Laboratories (DNL), was not feasible at that time and SPAWAR had begun to utilize the Federation of System Analysis Directors (FOSAD) to create this needed link.

Thus, at the end of 1986, our anticipations outweighed our concerns. Yet, all of us had in the back of our minds the concern that another financial control awaited us in 1987, and wondered if it would be the straw to break the camel's back.

As I review 1987, I see four subjects emerging in each quarter of the year: Cycle III; Warfare Systems Architecture and Engineering (WSA&E) and Wargaming; controls; and business processes. I'll cover each quarter and describe the highlights in these four areas, as appropriate. Other management issues of interest will also be covered.

First Quarter

While the strategic planners were defining the details of Cycle III planning, the analysts from our Surface Warfare Analysis Office had been tasked to conduct a *Needs Study*. The study began with a detailed examination of the threat as it related to the NSWC mission areas. It also explored the "environment" as it related to the economy, world conditions, force level, technology, etc. These data were then assessed relative to the warfare appraisals, current R&D/procurement programs, fleet needs, and NSWC programs. The net result was a statement of deficiency and opportunity (including technology availability for each warfare area and the products of our seven technical sectors.) The sector leaders, therefore, had a macro need assessment to begin Cycle III. This study was documented and during the year was briefed to

SYSCOM and OPNAV sponsors for their use and our verification.

In WSA&E, the FOSAD, which was chaired by Dr. F. E. Baker of NSWC, began to work closely with SPAWAR-30 managers to define analytical roles for the Center's analytical team. As we were to see later in the year, it was also the opportunity SPAWAR-30 needed to specify an overall involvement in WSA&E by each R&D Center. NSWC, by the FOSAD leadership and strong system engineering support to SPAWAR-30, gave SPAWAR-30 a strong commitment for providing quality architect and engineering resources and concepts.

The MTP was being managed, but the allocations in each department were such that the addition of recruited college scientists and engineers (S&E) appeared to overspend its MTP allocation. This would have meant a second year in a row in which college recruitment would yield less than 75 hires. Therefore, we decided to accelerate our recruitment efforts since a continual influx of new S&Es is the lifeblood of an R&D Center. This was discussed with SPAWAR and we received a higher recruitment target. This proved fortunate because quality S&Es were still available and over 130 new people were hired from college recruiting. Co-Op's and other S&E hires provided the Center's desired annual intake of about 230. The impact on MTP remained to be seen.

The annual Report to the Community held at Dahlgren in late March drew many community leaders and the program was different from previous years. Captain Anderson told his audience about our Cycle III process and the impact of controls, which could impact the amount of funds available outside our gate. He also noted the impact of our tenants commands in bringing in an ever-increasing sailor population—over 1,000—to the Dahlgren community. Thus, the community would have to work with NSWC to support this new population in the surrounding counties. Finally, Captain Anderson indicated that he planned to move all NSWC employees back on base,

ending our earlier decision to solve space issues by leasing property outside the gate. This resulted in two significant opportunities at the Center: First, it put in motion activity to work more closely with community leaders on traffic, recreation, and other issues. Second, our Public Works Department developed a very creative and detailed plan to solve our own space problems.

Business reviews continued to mature and the Center managers held a detailed review of the overhead budget to assess NSWC's investment in this area. These actions helped prepare us for the next control we had to face, when SPAWAR imposed an overhead dollar limit on NSWC for FY88. Our 1986 end-of-year concern of more controls became a reality.

Our last Inspector General (IG) visit took place over four years ago. Lessons learned from that review prepared us for the next IG visit in the summer. Under Capt R. G. Landrum, NSWC Deputy Commander, a team with membership from every department prepared well for the visit. All instructions were reviewed, IG and audit findings followed up, and mock inspections planned. The Summer 1987 visit was delayed to July 1988, but we had not wasted our time. This preparation had the added value of complementing the monthly business reviews to improve our corporate business practices.

Second Quarter

The Center Planning Office completed a Cycle III process and briefed Center management. There still remained a lot of work for each section leader and strategic business unit (SBU) manager, but the purpose was different and the CO and TD were tasked to develop their personal "vision" of the Center as guidance for sector leaders.

Out of Cycle IIA, we learned divestitures were not possible merely by writing a letter to the sponsor telling him that the Center was not going to support their need. Thus, Captain Anderson tasked the Center Planning Office to

conduct a study to assess the priority of surface warfare programs. This would help us in setting our own program priorities so that if divestitures were required we could demonstrate to our sponsor that the program was also their low priority. OSD and Navy priority systems were used as the basis for this, as were interviews with the sponsors who make budget priorities. We found that a single surface warfare list did not exist. Our study was very useful but verification was difficult. Like our *Needs Study*, we briefed SYSCOM and OPNAV managers for their information and to achieve at least informal verification.

SPAWAR-30 now realized that the R&D Centers had to be given specific assignments, and each had to have a WSA&E organization. In June, the following direction was received: NSWC was to be the Principal Technical Agent (PTA) for Electronic Warfare and Mine Warfare, with major support in almost all other warfare areas. (NSWC had also requested to be PTA in antiair warfare, but this was given to the Applied Physics Laboratory/Johns Hopkins University); we would form a coordinated warfare group (CWG) with department head access and strong CO/TD support; NSWC would staff an R&D center CWG to carry out responsibilities, and assign S&E's to a SPAWAR core team. NSWC responded to this direction through vigorous leadership—from the CO and TD to our best system architects and engineers. We formed a project office in the Combat System Department (N06), and a staffing level of 21 was achieved by year's end. The major issue was funding, because this new but significant program had not been properly budgeted. The R&D Centers used their overhead to support their efforts, and the term "funded by greenstamps" became a new term across the Centers.

Controls were not an issue in this quarter as the management systems and culture of controls were working pretty well. However, our Supply operation did, in fact, go to a contractor. Through the Commercial Activities (CA) Program, a reduction in force (RIF) was conducted. The Personnel Department's

thorough preparation together with the outstanding cooperation by all managers minimized the impact on our people. The transition to the contractor did, however, cause significant impact on our prompt payment process, and caused us to exceed our interest payment thresholds.

Several other significant events occurred in 1987. The second annual NSWC Technology Symposium was held on 19 June, whose theme was "Science at Sea." The symposium focused on some important technological developments by NSWC scientists. As part of that event, Dr. Ernst W. Schwiderski of the Strategic Systems Department received the NSWC Science and Technology Award. In addition, the Auditorium at White Oak was dedicated to Dr. Ralph Decker Bennett, the first technical director at the Naval Ordnance Laboratory. A distinguished guest speaker was Dr. John Bardeen, twice winner of the Nobel Prize in physics, who shared his views on superconductivity. It was a very rewarding experience for all who attended.

A key focus at the Center in 1987 was to develop a stronger manager corps. Toward that end, the Management Development Panel completed its structuring of a *systems approach to manager development* by formulating in-house training for first-line supervisors and branch heads. During this period, Dr. Hill and Captain Anderson began quarterly meetings with supervisors to share views, needs and issues.

Third Quarter

As planned, Captain Anderson and Dr. Hill jointly prepared their "vision" for the Center. Their "vision" was that NSWC would continue to be a full-spectrum RDT&E Center in order to strengthen surface warfare. The Center would continue with its broad-based mission, using a stable workforce (remaining at about 5,000 employees). Their collective desire was to focus and strengthen NSWC's technology to provide a balance between a generic and applied (ready-for-transition) program. In their vision, the Center desired to prioritize its workload and to control new work. As a special thrust, the

Center would form a surface warfare partnership with NSWSES to achieve the correct and distributed life-cycle process for software-intensive systems. Their initial vision was reviewed and discussed with the senior manager team, and a revised vision was published. The sector leaders then had the needs and priority studies and the *Vision Statement* to develop their sector plans.

During this quarter, N06 structured the Center's response to a WSA&E organization and process. However, this quarter focused on three "wargaming" events: the Global Game at Naval Weapons Center (NWC); demonstration of the Seminar Analysis Wargame at NSWC for SPAWAR-312; and conducting a Seminar Wargame at NSWC in cooperation with NWC.

The role for the Global Game was to organize and manage an advance technology cell for NWC. A feature of the cell was the warfare seminars; NSWC engineers would serve as leaders for AAW and amphibious seminars. Significant understanding between operational warfare needs and technology resulted.

The SPAWAR-312 demonstration saw NSWC, and in particular the Surface Warfare Analysis Office, taking the lead in demonstrating a new concept for assessing an architecture by integrating seminar gaming and analytical techniques. An impressive multi-Center team provided warfare expertise for all but ASW, which the contractor team supported. While not meeting all expectations, the concept was demonstrated. This later resulted in SPAWAR-312 supporting a Seminar Analysis Gaming Facility at NSWC. NSWC was to have both the architecture drivers development and architecture assessment leadership using the demonstrated technique and planned facility. A multimission, multiplatform model, named RESA, would be the key analytical tool. An advanced modeling concept, called ADMRALS, was also supported. This model is being developed by the Strategic Systems Department.

The final event was a seminar game using an arctic and amphibious scenario. The seminar

integrated NSWC technologists, warfare system engineers, other warfare experts, arctic environmental experts, and threat experts. The game was very successful and resulted in better understanding of environmental issues facing NSWC systems as varied as AEGIS and SEAL weapons.

As the quarter ended, a survey of controls showed NSWC was very successful. Carryover, competition, small business, and 70-30 rule objectives were all achieved. Our processes for MTP worked, and by making award pay-out part of FY87 MTP and our accelerated S&E hirings, we spent \$174.2M of the \$175.2M control—well within the specified bounds of ± 1 percent.

During this quarter we introduced the new Flexitour Program, an action spurred by the Center's extensive use of "first 40" at Dahlgren. Flexitour was developed by the Personnel Department as a way of achieving greater flexibility for managers and employees. Its primary feature allows an employee to earn up to 24 credit hours for working more than 8-hour days; the employee could then take these credit hours as leave days. As we got used to it, it proved to be a very popular process.

After several months of study and much discussion by the NSWC Board of Directors (BOD), a new decision-making process was inaugurated. An Executive Board (CO, TD, Deputy CO and Deputy TD), four Resource Boards; and a principals Board of Directors (all department heads) provided the framework for the process. The concept was for the Resource Boards to examine issues and initiatives, formulate options, and make recommendations for BOD assessment and for Executive Board approval. The Resource Boards would deal with the areas of financial/business; human resources; facilities; and technical. All of the Center's ad hoc committees report to the appropriate Resource Board. The rest of the year was the "pilot" for this new decision-making program, however, it appeared to be functioning well.

It was timely to introduce this process because ACP funds were showing a decline; STAFS was

falling behind schedule in its delivery to NSWC; and an overhead control of \$145.5M was defined for FY88. The financial resource board took the lead in defining a very detailed process for reviewing all aspects of our overhead plan. Each department presented its budget to the Resource Board, which had worked with the Comptroller Department to make an independent evaluation and then recommended allocation. Most of us came in too high, and significant cuts had to be made. (The first quarter of FY88 showed the Resource Board to be right, as most of us ran under the allocated budget.) While we didn't like the imposed budget cuts, it demonstrated the Resource Board concept had merit, including being the strong advocates of our support departments. Frequently, the support departments have to make difficult and unpopular decisions. Now they had a forum to support their decisions.

Fourth Quarter

Strategic planning, a new DNL, and FY88 start-up consumed this quarter.

In October, each department was allocated three to four hours to brief the BOD on its sector plan. A very open and candid discussion followed the brief, and the sector leader had to defend the sector's "vectors" and overall plan. Captain Anderson and Dr. Hill listened and then integrated all the information relative to the Center's requirements and vision. The result was a very powerful model, which set work priorities by warfare areas: 1,500 workyears for Surface Warfare and Strategic; 1,000 workyears for the three matrix warfare supported departments; and 600 workyears for ordnance, Marine Corps, and mine warfare. It also stated that 1,900 workyears would be allocated to the support departments. Key limits were set. The workforce would remain about 5,000 and contracting would not exceed 50 percent of the Center's budget. Importantly, the model supported a full-spectrum atmosphere, which balanced hardware and software, components and systems. This model was then the focus of a one-week management workshop held in Williamsburg, Va., in December, which resulted in verification of the model and guidance

developed by the CO/TD on the relative vector of each sector (technical and support). The workshop also covered a discussion updating the Center's little "blue book." (*Management and Program Planning Guidance, April 1985*)," and set the stage for tactical planning in 1988.

As an indication that the Navy and R&D operate in a very complex arena—including cultural, social, and environmental—the Navy's explosive and electromagnetic (EM) testing in the Chesapeake Bay became an intense issue. An accidental fish kill and concern about the impact of EM pulses on the environment caused NSWC to develop technical impact statements that got the attention of the two U.S. Senators from Maryland as well as many State officials. By the end of 1987, the issues weren't resolved, but it had become clear that R&D testing on the Bay was at risk.

Productivity remained a Center thrust, and Captain Anderson lent his strong and personal support to the new Model Installation Extension Program (MIEP) and gain-sharing programs. MIEP had been implemented in mid-year and by year's end several employee suggestions for eliminating unneeded processes or improving processes had been accepted. Gain-sharing is a program to increase productivity and save costs, with the added incentive of sharing the saving with the employees. The Center presented a strong case to become the pilot R&D activity for the ASN (S&L), the who sponsored gain-sharing program. The Naval Personnel R&D Center (NPRDC), which evaluated the activities, gave NSWC a high score based on current efforts and management support.

Dr. Hill had tasked NPRDC to do an independent Organization Effectiveness (OE) Study to assess our ongoing productivity efforts over the last five years. Results were most interesting as the Center got good marks for communication; but found the employees wanted more consistency from management decisions, more risk-taking, and a more aggressive resistance to external controls. Each department head is responsible for taking the appropriate OE actions, as tailored to its people.

FY88 began without Congress having appropriated a Defense budget. In the past, "work-arounds" have minimized the impact. This time the impact of the continuing resolutions, no carry-over, deficit reductions, and program cuts/cancellations made start-up difficult. The Center enforced Commander Orders, and NSWC Line and program managers faced a real challenge. The year ended with funding received being at a much lower level than planned and that history would indicate.

Dr. Jerry Reed was appointed Director of Navy Laboratories during this period. He immediately took control and leadership. His first visit to the Center was a good indication. He received a detailed assessment of NSWC's "state of the union" by the Deputy Technical Director, and he immediately grasped the key strengths and issues. At the first CO/TD meeting, he established leadership across SPAWAR and the Centers. It was clear he wanted the Centers to work as a team. We immediately were tasked to support him in clarifying Center mission/leadership roles. NSWC was specifically tasked to: (1) develop a process to assess annually the Centers; (2) develop a process and instruction to conduct the R&D phase of an IG inspection; and (3) form a unit at NSWC to provide management and evaluation support to DNL.

Thus, the year ended as it had begun. We had anticipation that the tactical planning process would be successful because it had a strong foundation from our Cycle III strategic planning. We were also seeing WSA&E plans and work become products as SPAWAR-30 stabilized its tasking. Our concern, however, now included the allocation for MTP and overhead (OH). Would our managers be able to balance both in light of the FY88 budget issues? The first quarter of FY88 provided no trends that caused us to change allocations, *but* the quarterly data showed income was down, MTP was over, and OH under. We also had the July IG, which would determine if our business improvements were successful. Therefore, 1988 would begin with continuing to deal with new corporate issues and facing challenges for the Center's future.

NSWC Technical Products

NSWC Technical Products

As a Navy center of expertise for several mission areas (surface ship weapons systems, ordnance, mines, and strategic systems) and numerous special leadership areas, the Naval Surface Warfare Center provides many different products and services to multiple customers at various times in their systems' life cycles.

The Center tries to integrate the development of technology with the development and acquisition of new systems—and their lifetime improvement—to give a planning and resource management focus for the whole program. The highest level of planning structure for the NSWC technical program is the business sector, of which there were eight in 1987, described below.

1. TECHNOLOGY Sector—dedicated to developing and maintaining a strong, aggressive future-oriented technology base supporting the Center's mission and goals. The Strategic Business Units (SBUs) in this sector include:

Sensors (electro-optics, electromagnetic, applied mathematics, solid state and nuclear)

Directed Energy (particle beams, lasers, high-power microwaves and kinetic energy weapons for hard-kill and soft-kill applications)

Energetic Materials (new energetic ingredients, detonation chemistry/physics, application of explosive to components, underwater weapons warhead technology, lethality of underwater warheads and vulnerability of underwater targets)

Weapons and Space Materials Technology (weapons and spacecraft technology block, nonmetallic materials, metallic materials, advanced materials, and materials evaluation)

Electrochemistry/Biotechnology (electrochemical power systems, corrosion technology, and biotechnology of materials)

2. COMBAT SYSTEMS Sector—provides full-spectrum engineering for all surface warfare systems, at battle force, combat system, and selected element levels. The SBUs in this sector include:

Cruise Missile Weapons Systems (systems and software engineering)

Combat Systems Engineering (Center focus on WSA&E; requirements, definition, and evaluation of surface ships; design and development of surface ship combat systems)

Combat Systems Technology (Center thrust for Combat Systems Technology and ATD and rapid prototyping initiatives)

AEGIS (Centerwide involvement in full-spectrum engineering and management of principal surface combatants through 2000+)

3. SURFACE-LAUNCHED WEAPONS SYSTEMS Sector—provides technical expertise and leadership for RDT&E of Navy and Marine Corps Surface-Launched Weapons Systems. The SBUs for this sector include:

Missile Weapons Systems (flyaway systems, launcher systems and ship weapons control systems)

Gun and Directed Energy Weapon Systems (systems analysis/systems engineering, ammunition, including fuzing, launcher systems, and ship weapon control systems)

Marine Corps Weaponry (weapons development and advanced weapons systems)

4. ELECTROMAGNETIC COMBAT Sector—provides the Navy with the capability to control and use the electromagnetic spectrum through technology base development, engineering, evaluation and fleet support for devices and systems that use the electromagnetic spectrum

to detect, track, identify, disrupt and conduct force coordinated electronic warfare. The SBUs for this sector are:

Electronic Warfare (force coordination and integration of EW and intelligence; counter C3; surface EW systems and integration; and EW readiness)

Search and Track (low observables; local area defense sensors; area defense sensors; and support of SPY-1 fleet introduction and upgrades)

5. STRATEGIC SYSTEMS Sector—provides requirements; technology base; development; and fleet support for many strategic weapons and space systems. The SBUs for this sector are:

Submarine-Launched Ballistic Missile (SLBM) (fire control analysis, equation, and software)

Re-entry Systems Technology (design and ground testing)

Targeting (analysis; modeling; and processing)

Technology Applications (improving systems performance; meeting new threats; and developing new weapon concepts)

Space and Geodesy (software analysis for satellite systems; simulation/analysis support for warfare systems architecture and engineering; exploration of spaceborne sensor systems for astronautics and geodesy; and space technology and applications). The primary thrust of the sector is to design survivability into fleet modernization by having more impact on the concept and engineering development phases of system evaluation.

6. PROTECTION Sector—provides technology base, engineering, and fleet support for safety and survivability of fleet warfare systems. The SBUs for this sector include:

Safety/Security/Environment (systems safety analysis; nonpointing/nonfiring zones; blast effects; shock/vibration/climatic effects; and shipboard security)

Nuclear and EM Effects (analysis, testing, and hardening in the nuclear and E3 fields)

Survivability (chemical warfare technology and protection systems; magnetic silencing; and ship structure design analysis and hardening)

7. UNDERWATER WEAPONS SYSTEMS Sector—providing for developing underwater weapon systems and combat systems that effectively counter the Navy's future threats. The SBUs in this sector include:

Surface ASW Systems (ASW systems development; AN/SQQ-89 systems engineering and integration; Mk 116 ASW control system; and mission-critical systems sciences)

Mine Warfare (MIW system architecture; mine technology; mine systems; and mine delivery systems)

Underwater Warheads (torpedoes; surface ship torpedo defense; and mine neutralization systems)

SEAL Weapons (special weapons; and standoff weapons)

8. ENGINEERING AND INFORMATION SERVICES Sector—providing design and manufacturing services; technical information

and audio/visual services; and product assurance as well as support to Navy acquisition programs in reducing the cost of engineering development and production. The SBUs in this sector include:

Design and Manufacturing (design disclosure drawings; structural analysis; CADD operation and application; mechanical prototype hardware; electronic prototype hardware; weapon system packaging designs; and metrology)

Technical Information and Audio/Visual (audio/visual, publications, graphics, technical library, and technical information technology)

Product Assurance (reliability and maintainability engineering, quality assurance configuration and data management; human factors engineering; integrated logistics support; and testing technology)

NSWC Technical Assessments

NSWC Technical Assessment

by Dr. Lemmuel L. Hill



Dr. Lemmuel L. Hill, NSWC Technical Director.

In 1987, NSWC continued to be a leader, forging ahead on new frontiers and pioneering new technology to strengthen our fleet. We also brought into more specific focus where we, as an R&D laboratory, are heading in relation to the Navy's future needs and strategies. I would like to highlight some of the areas I feel were important to NSWC last year.

Multisensor integration is one of the most exciting things NSWC has done recently. It took a guy like **Tom Pendergraft** (F40), with the support of his team and the guidance of **Ted Williams**, to recognize that—with the advent of faster, harder-to-see, low-flying observables—radar, electro-optics, and even electro-magnetic support measures, when used separately, are not adequate enough to protect our ships. So what did we do? We grouped these conventional devices, came up with a few hare-brained ideas (which we have in place), and put some packages together. We are still in the process of learning, improving, and building on our ideas,

and on the ideas from other people around the country.

Tom and his folks have been collecting pieces and experimenting with various approaches for some time. This past year, his team put it all together and did some interesting tests down by the river. I think it has been a very successful experiment, so far—it will be a couple of years before all the wrinkles are ironed out. This kind of project is one of the reasons NSWC is on the map. When we took the CNO and some two-stars and three-stars to see it, this project turned out to be a favorite stop on our VIP tour. They all got the message—and the message is: if you want to try new things—from hare-brained ideas to new ways of combining pieces—the laboratory environment is the place where it works best. The message has been very clear and they have all supported us very well. It's why we're here—to find more innovative ways of solving problems.

From an operations point of view, I think the event that had the most impact on the Navy in 1987 was the *USS Stark* incident. Within hours—24-36 hours—after the missile attack, critical components and software (associated with the SLQ-32 system) from the *Stark* were actually on site. We then proceeded to do our “Quincy” act—remember Quincy on TV, who tried to find things no one else could find?—that's just what we tried to do. We attempted to reconstruct the event from available information by replaying the situation using computer simulations and some of the real equipment.

When the missile hit, the computer went down. As soon as the crew could, they reloaded the computer over the old core. The old core had the memory that was present just before the shot. We tried to analyze what happened by getting at that valuable information. Security people have been telling us for years that to obliterate information on a hard disk, you should write over it many times. If the same logic is applied in reverse, maybe the original information can still be found. It was our understanding that the crew tried to reload the system three times. We tried to peel back that

data, loaded over three times, to figure out what was underneath.

I am very proud of this organization's ability to respond and literally work around the clock to get things done. If you had gone into the SLQ-32 room after the *Stark* incident, you would have found people sleeping in the corner . . . people who had been working 24 hours a day, without sleep, trying to solve problems. They really showed tremendous commitment and made an outstanding effort. If the flag goes up, I'm confident that we will be ready and able to perform. That is one of the reasons for having an organization like NSWC.

I gave a talk last year about our Underwater Warhead Analysis Facility. I prepared vugraphs and went out there to tell them about this wonderful new facility at NSWC. When I got up to talk, I suddenly realized it was not a new facility at all—we've been doing this for 20 years! But what we've been doing is connecting a 3,000-mile data link to the large-scale, powerful computers at places like Livermore and Los Alamos.

The traditional way to investigate and do warhead analysis has been through batch-mode processing: you plug in all your data, make a run, then examine the data. Now, at NSWC White Oak, we have an almost analog ability (although it is still digital) to act with the system. We can observe what is happening in almost real time, slow things down, make a change, and see how it accrues. That's a tremendous accomplishment. We're pretty proud that we were able to put that advanced design analysis capability together here.

Warfare Systems Architecture and Engineering (WSA&E) is a philosophy that, like Newton's apple, has fallen and hit us on the head. Some of us are crying, "Eureka!" the way Archimedes was supposed to have said in his time. There is no way to put the apple back on the tree; WSA&E is here to stay and will ultimately take hold. Like anything new, it has its critics and its champions. There may be periods when the critics will win for a brief period, but I think the champions will still

prevail. In my opinion, it is so right that the first thing you say is, "Why haven't we been doing it that way for the last 20 years?"

In a way, AEGIS started it. (At least for surface ships—perhaps the nuclear submarine program and POLARIS cast the mold.) AEGIS was the first successful, highly integrated combat weapon system. Because the AEGIS accomplishment stands out like a bright, shiny penny, people naturally say: If you can integrate a combat system aboard one ship, why not integrate the effective operation of two ships? It's the logical next step. Two ships are not a natural grouping, but a battle force is, and that's the WSA&E goal. It's a big step—but we will get there some day.

Last year, several initiatives were realized when we began some new management training programs. Three or four years ago, we began to identify some recurring problems that we realized should not be up at our level for resolution. While first-line supervisors were doing a good job, they were not doing the total job. We asked ourselves why. The answer was that we were not doing a very good job of training our first-line supervisors. We were literally saying, "Hey, George or Jean, you're great. You're going to be a first-line supervisor now. Congratulations. See you later." And they would say, "Now what do I do next?" So in 1986/7 we piloted the *Supervisor Development Program*, a nine-week course consisting of 18 half-day sessions. This program focused on sharpening the leadership and interpersonal skills necessary for successful management.

Last year we also conducted our first class in a course developed for branch heads called the *Leadership and Management Development Program*, a two-week, intensive residential workshop. This program is aimed primarily at those people who are relatively new to their branch head jobs. When the course was first introduced, I asked people to mention how long they had been branch heads. Their answers ranged from one week to twelve years! So, "new" has to be viewed in relative terms. The advice we gave them was, "You twelve-year

people keep quiet and listen for a week, because you know what the current problems in management are—ones you may have forgotten about.” When I went back to the closing session of this training course, the enthusiasm of the students was at such a high level, I’m afraid I had to pour a little water on them!

It took a long time to design these programs. My hat goes off to **John Tino** (D2) and all the members of the Center’s Management Development Panel, who organized the courses from basic management training skills material. I think all the members of the panel did a superb job developing and executing these two programs.

In terms of budgetary changes, 1987 was sort of a neutral year. I’m not sure I could point to any budget constraints that seriously impacted our technical progress. Uncertainty still remains in the Defense budget; obviously, the Navy’s share of that is our concern, I doubt that we are looking at a period of growth in the future, but I have confidence because of our efforts in strategic planning.

Our willingness to prioritize our work is another major accomplishment—and our military leaders deserve a lot of credit here. We were doing a pretty good job of strategic planning, but really hadn’t taken the last step, which is perhaps the most important one. The military understands, perhaps better than civilians, the need to prioritize. We have done those prioritizations. It irritated some of our people, but I think this type of planning was important for us. Because of our willingness to take on the tough issues, I am confident about the future of our technical programs.

Last year we saw the appointment of a new Director of Navy Laboratories (DNL)—**Mr. Jerry Reed**, who brought an integrated approach to the management of the R&D centers as a whole. That was the achievement of a major goal. The corporate entity called the Navy R&D Centers is a group that is very much worth saving. In spite of the criticisms of some people, we do not duplicate each other’s efforts; we work as an integrated, effective team in the laboratories, doing sound, technical R&D that the Navy critically needs.

***NSWC Department
Accomplishments and Assessments***

Engineering Department Accomplishments

by Richard P. Benedict



*Richard P. Benedict, Senior Product Assurance Staff
(E301)*

The Engineering Department (E) ensures NSWC develops high-quality, accurately documented systems for the fleet. We provide support to over 150 Center programs, ranging in terms of effort, from one manweek to 75 manyears (including contractor support). The different technical skills within E include capabilities in design and documentation, cost control and analysis, prototype manufacturing, writing, and photographics, just to name a few. Within the Product Assurance Group alone, we have skills in reliability and maintainability, quality assurance, integrated logistic support, and configuration management.

Being a centralized support group familiar with the many programs at the lab, our people can work on a mine system one hour, then solve a decoy problem the next. The variety of challenges our people regularly rise to amazes me. While continuing to be technical experts in many areas, we also maintain a broad outlook on new R&D in the entire Navy community.

Our biggest accomplishment in 1987: We began the upgrade of our equipment and facilities to improve the quality of the support we can offer to the Center's programs. In terms of automation, during 1987 we initiated the machine shop modernization program. There, we integrated numerically controlled machines with our CADD (Computer-Aided Design and Drafting) system to enable our customers to develop ideas and see them quickly translated into hardware. Once tested and analyzed, the hardware could also be modified in a timely manner. In the Technical Information Division (E20), we formulated an automation objective to integrate the writing, word processing, and graphics functions in one computer system that would allow us to quickly deliver a complete information package, such as a technical report, to the customer. The photographic branch continued modernizing its equipment to expand the scope of the technical photography services available to Center personnel who document and analyze test results. Our cost control and analysis group continued the development and application of a model for contract and engineering change proposal cost negotiation, as well as initiating the development of a model for R&D costs during the concept development phase of a project. All of these programs were started in 1987 and will be ongoing for quite a number of years.

The biggest challenge we had in the Engineering Department in 1987 was the problem of effective staffing. By this I mean our personnel's continual development of technical capabilities to meet the needs of our customers. Over the years, recruitment of new personnel has been difficult because engineers straight out of college want to design something. Our functions in E Department are not so much oriented toward design as toward the technical support of that design. Although today's students have a solid background in one or more specializations, many of our tasks, such as reliability analysis, cost analysis, and integrated logistic support, are not taught as majors in college—the working knowledge of these fields must be acquired primarily on the job and in

advanced formal training. The big question has been: How do we develop new personnel to perform this kind of work?

The retention of our personnel has been below average compared to the other technical departments. In 1987, we began investigating the probable causes in order to develop a strategy to recruit and retain the personnel we need. On the other end of the spectrum, as a relatively old group, we are losing seasoned personnel through retirement. So in 1987 we began to develop "expert systems," which assimilate the knowledge and experience of our senior people, gained over the course of the years, to pass along to our younger personnel.

In 1987, we saw the continuation of a shift in the type of technology we primarily support: from component design to software and systems integration R&D. As the Center's balance of work shifts from component design toward systems engineering, we in the Engineering Department must develop the skills and knowledge required to support these new efforts.

One of the consequences of the shift from component to combat systems work was that E Department devoted time and money to train its people to support these new efforts. The expertise we accumulated over the years supporting components is still valuable, but the value declines as our emphasis on software and systems integration increases. It was a challenge trying to develop the skills necessary to meet these new thrusts of the Center. Our amount of work went up, while our number of people went down. This squeeze forced us to create new technology, productivity tools, and techniques. For this reason, I believe that the automation and training investments made by our department were crucial in preparing us to fulfill the Center's present and future mission.

I feel the quality of our achievements is increasing all the time. The basic way we measure success is through customer interface and fleet progress. Our primary feedback comes from the program managers themselves. One

unfortunate thing, in some of the engineering areas we support, is that measurement of our technical achievements is difficult during the R&D cycle. We can do reliability analyses and predictions, but we rarely have enough hardware and time to test and establish proven reliability figures—until after the equipment or system has been in the fleet for a number of years. In contrast, in the technical manual area, we can write a manual, validate it by running through the procedures (under certain controllable conditions), and then allow the fleet to check it also.



A high-speed video shutter camera records the separation of a QUICKSTRIKE Mk 62 mine from an aircraft—the final picture is in the center.

Feedback on our performance also comes from our own internal quantitative measurements. By that, I mean not only the many years of effort we put in, but also the effectiveness of the product for that expense. For instance, in the shop area, a low number of pieces reworked is a measure of our success; in the software quality field, it's the minimum number of bugs detected and removed. We ask ourselves: How many times did we rewrite documentation because we made mistakes—not because the system design was changed?

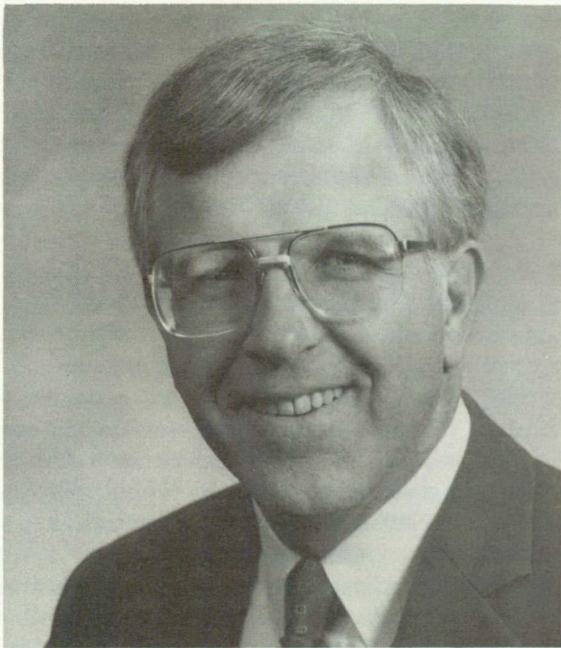


NSWC's modern machine shops include numerically controlled machines, which are directly linked to the Computer-Aided Design and Drafting system.

Over this past year, I think the Engineering Department had a very high degree of success. We had some disappointments, too—but we learned from our mistakes. Our primary goal remains to provide high-quality service to our present customers, while preparing ourselves to support the Center's future initiatives.

Engineering Department Assessment

by Dr. Thomas A. Clare



Dr. Thomas A. Clare, Head, Engineering Department (E).

The Engineering Department (E) is unique among the technical departments because it is a service organization for the Center and, at the same time, has a significant scientific and engineering skill base. We offer other departments, and the programs they work on, our capabilities in product assurance, prototype hardware manufacturing, and our services in technical information: the library, writing/editing, audio-visual, and photographic branches. In addition, we support the Center's and Systems Command's program managers in cost analysis and cost control. The diversity of our services and the versatility of our personnel, who provide the support and solutions primarily to the Center's departments, make us unique. In turn, that uniqueness presents us with many interesting challenges and opportunities.

Before discussing E Department's accomplishments in 1987, I would like to stress the department's people. In a very service-oriented organization such as this one, our attitudes, values, and performance tend to be

more amplified because in our mission we are dealing directly with the customer. In 1987—my first year as head of E—I was impressed by the caliber of personnel in this organization. The people here have a “can do” and “will do” attitude. Recognizing that their customer is by and large NSWC, they embrace and internalize a feeling of commitment. I have found our people to be excellent problem-solvers: seasoned, knowledgeable, and able to carefully weigh the pros and cons of a situation, then use their initiative to make the kind of decisions that will improve the quality of services rendered to the Center.

Moving from our people, I would like to discuss the 1987 accomplishments primarily in terms of how we are making improvements in order to more efficiently fulfill our mission to the Center. I'll discuss three areas: (1) the initiatives we made to improve our technology, facilities, and services; (2) how we successfully articulated our services and mission to the customers; and (3) how our increased efficiency and better self-definition benefitted the Center.

Regarding the first area, there are several important items I wish to highlight. First, in E30, the Product Assurance Division, there was a need to make the technology base stronger for the future of Product Assurance. For example, we must answer the question: What does it mean to deal with the product assurance discipline of reliability and maintainability in a software-intensive system as opposed to a hardware-intensive system? We set a goal to use 20 percent of our work effort in E30 to contribute to technology and develop tools and techniques that would enhance our ability to do product assurance in the future. For instance, our people have shown innovation in this area with respect to the database technology that supports the AEGIS Program. Here, existing database technology was creatively modified and made to support the nationwide complex of AEGIS ships and installations across the country.

In the modernization of our hardware prototype manufacturing area, we have

successfully embarked on a multiyear program of consolidating the shops, particularly at the White Oak site; the Dahlgren site is mostly consolidated. This includes modernizing them with computer numerically controlled machinery. Considerable investments have been made in this area and the capabilities have been significantly improved. The leadership on the shop floor and in the prototyping branch deserves a great deal of credit for continuing to keep this difficult and complex project on track. The Public Works Department has been very cooperative and has taken a strong leadership role in these modernization efforts. We are on the way to a consolidated, modernized shop at White Oak in 1990, supported, in a great measure, by the PIF Project that was approved a few years ago.

In 1987, upgrading the Dahlgren library facility became a top priority. Although the people who work there are outstanding, a grossly inadequate facility is impeding our ability to provide services at a level of quality consistent with customer demands. In planning the upgrade, we developed a strategy, explored several options, and made our recommendation known to Center management. Our goal was to provide additional space so that NSWC personnel can better take advantage of the library's resources. In 1987, the early planning for this renovation was done and the project's initiation remains one of our primary goals for 1988.

A specific automation area in which we are steadily increasing our efforts is the CADD (Computer-Aided Design and Drafting) system. The system allows designers to design from a database and have a two-dimensional or three-dimensional picture on the screen, as opposed to a two-dimensional illustration on a piece of paper. With CADD, engineers can calculate moments of inertia, centers of gravity, and make structural analyses. Before this system, many of these problems had to be worked out physically in a laboratory test environment. In 1987, we continued to try to bridge the gap between hardware design and fabrication. We are still working on electronically getting the computer

design to the machine that manufactures the part, instead of hand-carrying a paper tape from the computer to the lathe, or whatever machine. By being able to transmit the information electronically, that extra human involvement could be removed from the loop, resulting in a saving of time and money.

We made significant advances in the handling of technical information. In 1987, we received approval for the purchase of a Xerox computer system at the White Oak site that integrates writing, word processing, and graphics in one network. This system is compatible with the one in place at Dahlgren and will allow us to do some load-sharing between the sites electronically. Automation investments have gone into the technical library as well. The innovative equipment purchased in the photographic and audio-visual sections has resulted in enhanced documentation of test and evaluation results for the Center's scientists and engineers.

In the second area, defining what the Department has to offer, we produced a clear statement of our values, objectives, and strategies; then came up with an effective way of describing our work, products, and services in a way the customer could understand. This was our most significant challenge in 1987: corporately being able to outline what we can do for the customers in a way they could appreciate. How was this accomplished? Through many long sessions within our management structure. We kept asking ourselves: Are we communicating what the department does? Conveying what we are offering for what price? We spoke about our services in terms of quality and turnaround time. It was a process of objectively looking at ourselves through the eyes of the customer. We tried to make our products and services, across the board, understandable and more oriented to the departments' needs. The biggest challenge was bridging the information gap that existed before.

In the process of defining our objectives and strategies, we created a long-range plan that articulated our goals. In it, plans were laid out

for continued automation. Areas were highlighted that, in general, would need more time and attention, as well as some areas that might require less of our resources. We also made sure that the Engineering Department's direction and priorities were fully stated to corporate management. In 1987, I feel we defined what the Engineering Department is, where it is going, why it is going there, and how this will benefit the Center.

The third and last area, our increased efficiency in our service to the Center, was the prime result of our automation, planning, and effective communication of what we do. One of our major goals was to reduce the cost and turn-around time of our services. We maintained a high level of quality, and where possible, increased the quality and quantity under the constraints of the already reduced cost and turn-around time. This goal was set for the entire department. Our strategies for achieving this objective were varied across the division and product areas. In the Technical Information Division (E20), increased automation resulted in reduced costs and turn-around time. In many areas, there was an increased demand for our services. A lot of this is the result of being able to isolate and reduce costs, find better ways to get the job done, and be more cost-conscious in general.

Regarding cost-consciousness, our Cost Control Group saved the Navy approximately \$60 million by providing expert insight into manufacturing processes and their costs. The saving encompassed a wide variety of Navy systems, mostly under the cognizance of the Naval Sea Systems Command.

The criteria for evaluating our progress were updated. Realizable goals were set to indicate the desired level of performance in every area.

With tangible objectives in place, we monitored the progress towards our goals, and in a few instances away from them. With these indicators we could be sure that our limited time and energy were spent wisely. Where we were successful, we could acknowledge that achievement; where we fell short, we could more readily diagnose and solve the problem, or apply resources from other areas to the project requiring immediate attention.

These 1987 accomplishments are a credit to our people: progress and automation required the acquisition of new equipment, the training of personnel, and the adaptation of new skills and new mindsets—whether it was in a paper-oriented process or on the machine shop floor. The continued responsiveness and dedication of our people are very noteworthy. In fact, I'd like to close with an example of just how our people feel about their customers.

One of our employees went home on a Friday evening after a long week at work. While she was at home that evening, she received a phone call that a problem had occurred on an AEGIS ship in San Diego. The problem was of considerable importance and required information she was capable of delivering. She came back to work on Friday evening, called the airport to get a reservation for a flight out, went to San Diego, delivered the material, and returned to Washington on Saturday night. On Sunday, she spent the day recovering. Monday, she came back to work and proceeded as though nothing out of the ordinary had happened; she considered this just a normal part of her responsibility to support a customer. This kind of attitude is an indication of the type of people we have in E Department. I believe our technical and managerial accomplishments throughout 1987 are a credit to them.

Electronics Systems Department Accomplishments

by William J. Lewis



William J. Lewis, Deputy Head, Electronics Systems Department (F02).

In 1987, our folks set up a number of systems on the river range and began to collect data for multisensor, multifusion experiments. As technology leaders for developing advanced AAW sensors, especially in support of the NATO AAW Program, NSWC is providing the interim site for these integration tests. Because missiles are fast, low-flying, and hard to see, they are difficult to detect with a single type of sensor. Alone, each sensor has strengths and weaknesses, but in combination they complement each other. Experimenting with different mixtures, our engineers began merging the data so that the target could be more quickly and accurately seen, tracked, and engaged.

Working with as many systems we could get our hands on, our team tried new variations against similar targets and began the task of trying to integrate the data to accomplish the tracking. We attempted, and are still attempting, to get the fairest representation of what can be done in the 1995–2000 time period.

The primary question was: What are the best combinations of the future going to be? With this work, begun in 1987, we made significant contributions to the next generation short-range defense of our combatants. This opportunity arose in the early engineering investigation when some of our people took the initiative to say NSWC, especially Dahlgren with the river range asset, would be a great site for these tests.

Our department personnel are responsible for the AEGIS SPY-1A radar, and the next-generation B and D versions. We support the radar in the fleet, analyzing problems when they occur and developing new capabilities for improved performance. A fairly new system, we have worked on many ways to expand and upgrade it. We especially enjoy the “what if,” experimenting to enhance its capabilities. In 1987 our scientists and engineers made over 100 improvements to the SPY-1A; some small, some large, always attempting to make that unique, multifunction radar better able to perform the multimission requirements placed on an AEGIS-class cruiser.

We often designed new pieces of the system, then put them into the hands of bright sailors who find other ways to maximize their use or make them function easier. Fleet feedback is absolutely essential in our business. The small number of people at NSWC who work on the SPY-1A probably understand the guts of that radar better than anyone else in the world. Some of them spend a fair amount of time onboard AEGIS ships, interacting with the crew and understanding the requirements. As the principal support of this radar for the Navy, we have an active role and responsibility for the SPY.

We continued to support the AN/SLQ-32 Electronic Warfare (EW) system, the primary EW system in the Surface Navy. Our experts put out a new software load almost every year, which includes any accrued threat changes. Of major significance, last year’s revision improved the system’s capability in rapid raid response in potentially hostile areas of operation. We made

many other upgrades to the SLQ-32 to keep it current, trouble-free, and able to accommodate its new hardware.

Our people were heavily involved with the analysis of what occurred, from a SLQ-32 point of view, aboard the USS *Stark* in the Persian Gulf last year. For an extended period of time, a lot of dedicated personnel labored to correct deficiencies, enhance the system, and train the sailors how to use it more effectively. Because of our reputation for SLQ-32 expertise, we were called upon in a time of crisis to provide specialized assistance.

In the EW field, we successfully tested two cover and deception systems. The first, the Shipboard E/F Band Transmitter, met all performance expectations during several fleet exercises. One of our young double E's spent a lot of time at sea assisting the sailors in these exercises on several different ships. The second, the Offboard Deception Device Battery, excelled during its test and evaluation. These deception devices try to fool the enemy with fake electronic signature. For instance, you can build a device that simulates the RF signature of a SPY-1 radar. With such a system you can turn your real radar off; the enemy will see the false radar, send his forces there, while your ships are somewhere else.

Our biggest challenge last year was not technical, but managerial: how to prioritize and balance our efforts in a time when the defense budget began to decrease. Some programs were cut back, some stopped. Working with sponsors to scale down projects, we found selecting among programs very difficult—deciding what areas would have less impact. Funding for the defense peaked in the previous years; in 1987, we began to face the fact that the defense budget will decrease because of the national deficit.

In the Artificial Intelligence (AI) area, more strides were made, but we still have a long way to go. In some projects in the Independent

Exploratory Development (IED) Program, we started to investigate the applications of AI technology to the ways we do business. Though successful on a small scale last year, this work portends the biggest leaps in the future. If our scientists and engineers can develop software programs to function similar to the way a person thinks and acts, that will have a tremendous impact on how systems respond to the threat.

In a related field—intelligence processing—we developed, tested, and delivered the AN/SYQ-9(V)3 system to the fleet. A hardware and software package, this database allows the fleet to manipulate a wide variety of data on warfighting capabilities and multiple modes of attack. We had the responsibility of developing that here, transitioning it, and providing life-cycle engineering support.

Compared to 1986, last year's accomplishments were bigger and better. We measure this by our impact on the fleet. In general, we had excellent interactions with the Surface Navy, delivering many important R&D products. With items such as the SPY-1A radar, we took it to sea, watched it in action, tinkered with it a little bit, and improved its capabilities. This way, we could see the results and the impact right in front of our eyes.

From a technology point of view, we are moving forward, enhancing the Navy's resources so that the sailors can do the best job possible protecting this country. The Electronics Systems Department has a good reputation within the Center and within the Navy as a doer: give us a technical problem and we will solve it and deliver it to whoever needs it. As a result, last year, we received many challenging and complex tasks—almost more than we could handle.

Electronics Systems Department Assessment

by L. M. Williams, III



L. M. Williams, III, Head, Electronics Systems Department (F).

People in the trenches, not management, are the shining stars in the Electronics Systems Department (F Department).

They're the ones that make F the outstanding performer it is. The Electronics Systems Department is what it is because of the 400 or so capable, enthusiastic, and dedicated folks that make up the department. We also have some of the finest division heads and branch heads at the Center. Management's role is to provide leadership and the proper environment, and then get out of the way and let the folks doing the work do their jobs.

We work hard at improving communications in the department. One of the ways we do this is through town meetings, a process started by a former F department head, Bob Ryland. I meet with one branch a week, generally in their spaces, discuss topics of interest for 20 or 30 minutes and then answer questions. The whole process usually lasts about two hours. Current topics include guidance coming out of the BOD strategic planning workshop, what this means

relative to tactical planning, the new design review process, automating time and attendance records, and status of our MILCON. The return on investment of time spent in town meetings is tremendous. The improvement in communications and many of the benefits of MBWA (management by walking around) are obvious. One of the pluses is in the area of productivity. F folks are open and candid in discussions of work inhibitors. While management can't solve all the problems, you have to know they exist to try. We have solved some and are working others. There are quirks in the system, which appear minor when viewed in total department context, but being unable to get a needed ten-dollar part fixed can be a real "show shopper."

In the 1987 NPRDC survey, F department folks rated the Center's support department fairly high. In past years it has been, "I can't get what I need from Supply." I haven't heard that recently. Supply appears to be working hard to satisfy our needs. Another area of complaint used to focus on Public Works. Given the money, MILCON, and contractor performance constraints and the age of existing buildings, Public Works has done an admirable job of improving F's spaces. The additional parking lots in the hangar area have helped, too. Personnel Department has continued its excellent support to F. I think the support we get reflects the attitude and rapport F folks have established with the support departments.

I believe the environment in F is a very positive one. We have work that is challenging and demanding. We are involved in programs that make a difference in the world today. To develop an item and release it to the fleet one month and read of its success in the newspapers a few months later is very rewarding.

What accomplishment had the greatest impact on the Navy in 1987? Several worthy achievements come to mind. F's largest program is the AN/SLQ-32, the Navy's antiship missile defense threat warning and countermeasures system. It received a good deal of attention with its use by our ships in the Persian Gulf. This

system detects threat signals, identifies the type of threat, and in some versions, takes soft-kill actions to defeat it. A number of very innovative and effective system improvements were made to enable this system to perform correctly in very complex and dynamic RF environments. This system has proven to be very effective in fleet operations.

AEGIS is the premier combat system in the fleet today. The AN/SPY-1 radar is the eyes of that system, and F folks are the ones making it even better. They evaluate SPY's day-to-day performance and are responsible for several very significant improvements that have enhanced the ship's warfighting capability.

Today's land battlefield is a complex mixture of electromagnetic signals from friendlies, the enemy, and others blended with the earth's "nonstandard" environment. In 1987 the folks in F fielded an improved software package for the Marine Air-to-Ground Intelligence Systems (MAGIS). This system takes information from existing sensors and other data sources and helps the analyst decipher who is out there and what they intend to do.

The electronic world can also give us indications and warnings at tremendous ranges of what's going on, where the enemy is coming from, and how large his force is. This intelligence allows us the time to do something about it. F troops also designed ultracapable shipboard intelligence systems to sort out the profusion of data, and provide a clear picture to warfare commanders.

All the while friendly forces are sorting things out, some systems designed by our folks are making the problem harder for the other guy. These decoys make the enemy look somewhere we aren't and influence him to make wrong decisions. Other soft-kill systems make him shoot at the wrong targets or make his weapons miss.

Today our potential adversary can throw so much weaponry at us that we can't possibly shoot it all with bullets or missiles. We have to use electronic warfare more effectively. We have to decoy it, deceive it, jam it, or use some other soft-kill way of rendering it harmless. This is the driving requirement behind two major

strategic focuses in F: integration of multiple sensors to detect low-flying or nearly radar-invisible aircraft; and integration of soft-kill and hard-kill systems.

The challenge presented by low-flying aircraft or missiles is how to find them at wave top levels. By themselves, radars don't detect things very well at altitudes measured in feet. To compound matters, stealth technologies make the detection equation even more difficult, and at all altitudes. It may be invisible to one sensor, but stick out like a sore thumb to another. The folks in F40, Search and Track Division, are looking at technologies like electro-optics to help, not singly, but as a fused set of totally integrated, interacting sensors.

The hard-kill/soft-kill effort is focused in the RAIDS/EWCS program. The Rapid Air Defense System (RAIDS) and Electronic Warfare Control System (EWCS) programs are being developed to provide a self-defense system to the fleet. EWCS looks at integrating shipboard EW systems like AN/SLQ-32, Mk 36 decoy launcher, and LAMPS Mk III radar warning set into a threat warning and soft-kill system. RAIDS is a rapid prototyping effort that will better integrate the close-in-weapon system (CIWS) and SLQ-32, while coordinating ship maneuvers to minimize its size to an incoming missile radar and chaff deployment to deceive or seduce the inbound missile.

One problem is getting different Navy communities to work together toward a single objective. This was very difficult initially for those of us who came from the "blow them out of the sky" hard-kill world. The soft-kill EW system, which silently jams, deceives, or seduces the weapon to miss, lacks the noise, smoke, and excitement, but can be just as effective as hard-kill weapons. These poorly integrated systems won't be capable of defeating the enemy weapon of tomorrow. If they're integrated, and F, G, and N folks are working that problem today, they will more than meet the future threats. That's really the challenge: *Doing things today that will make a difference 10 or even 20 years from now.*

We are also working at the front end of technology, learning how to use evolving technologies, such as artificial intelligence and smaller, much smarter computers. A wealth of data is available for military decision-makers. In fact, we have more information today than the commanding officer can use to make decisions he needs to make in the time he has to make them. We are looking at how we can improve that decision-making process.

We are also working on what the battle force of the future is going to look like. We don't have the final answer, but we've got some ideas. We are the principal technical agent for Electronic Warfare Systems Architecture and Engineering (WSA&E). A group headed by Bill Lewis is figuring out how we're going to architect and engineer the electronic warfare contribution to win the battle. This stuff is important. Another thing I see happening in F department is we're beginning to move toward the front of the development cycle and more technology work. In addition to the programs we are doing today, we are beginning to carve out a manyear or two to work on the better idea for the future. Sometimes we can get so tied up in the work we're doing today, because the fleet needs it now, that we forget to look ahead. That's an area F department is moving

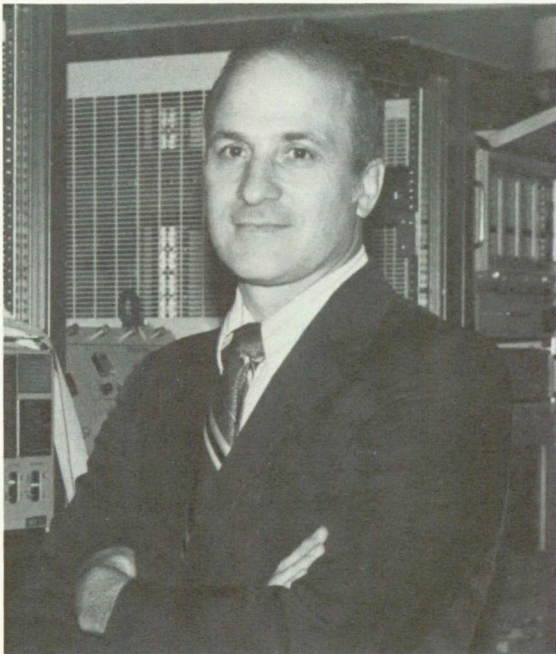
toward—the technology area or at least looking at what's next and developing ways to explore some of those ideas.

We are also moving towards systems vice component work. That's the name of the game. How do we support the mission of the ship vice developing a "black box" for some single use? We have to keep some work going on at the component and the element levels. It's generally excellent hands-on work and necessary in developing system engineers. That's another thing that has evolved. Not only are we balancing the type of work from fleet support through basic research, but also the balance of system vice component tasking. Doing hands-on component work provides folks with basic experience, builds their confidence to tackle a larger job, and starts the system engineering development process.

In summary, 1987 was an exciting year. The folks did extremely well. The programs continue to be challenging and rewarding. Strategic planning has focused our vision of what "Future F Dept" should be and our tactical plans have charted a course toward that end for the next couple of years. Bottom line: We are ready for an even better year in 1988.

Weapons Systems Department Accomplishments

by Dr. Normand Auger



Dr. Normand Auger, Senior Engineer, Weapons Control Division (G702).

Last year we began our work as system integrator in the NATO AAW Program. One of the Navy's most important projects, this multifunction effort is designed to counter the super-low, super-fast missile threat from the Soviet Union and other countries. The United States, along with West Germany, Canada, the Netherlands, Spain, and the United Kingdom, banded together to work on the system concept exploration phase. NSWC tapped expertise in its various departments to organize a group of scientists and engineers to support the program. Although the final AAW is due in the fleet in 1998, the AAW technology advances made along the way will trickle down to improve the defense of many ships by the year 1994.

The final AAW system will consist of a multifunction radar, consoles, computers, and weapons. NSWC's role is to make the system work as a complete package, successfully merging the data from many different sensors.

At present, we do not possess a single sensor that can detect all threats under all conditions, so we are assimilating various radars and sensors for better and earlier detection, tracking, and targeting of incoming missiles. Multisensor integration has been around for some time, progressing in a piecemeal fashion. Last year we realized that efforts in this area must be intensified and new mathematical formulas developed to deal with this problem. For this program, key sensors were installed at the test site and we have begun performing the sensor integration.

The NATO AAW Program presented us with our biggest challenge. Most systems under development involve a single contractor with a single nation. In this program we are working with six different viewpoints and requirements (that include various ship sizes, sensors, and close-in weapons systems). Making one system out of the various elements presents us with a great technical challenge because we must create common interfaces among the different pieces with an eye to how everything integrates with the various combat systems onboard ship.

We accomplished the certification testing of the Mk 160 Mod 4 Gun Computing System (GCS), scheduled to go onboard a new AEGIS destroyer (ADG-51) currently under construction in Maine. For this project, begun in 1982, we developed a great deal of computer software. The system includes two microprocessor programs, a couple hundred thousand words each. We also had to write a unique simulation program last year to test this system. In addition, our program leadership included developing a great deal of hardware. The next step is to transfer the system to the Combat System Engineering development site at Moorestown, New Jersey, for further tests, followed by shipboard tests in the fleet.

In the Battleship Improvement Program, a number of improvements were made to our ships. In 1987, we initiated a 16-inch Fire-Control System Improvement Program to increase accuracy and flexibility in controlling

the 16-inch guns. We also developed a new 16-inch bullet designed to hit long-range targets (in support of the Marine Corps) and supplied portable computers to the fleet so that more accurate ballistic calculations can be made. (The new PC programs compute variables difficult to perform on analog computers.)

Our Phalanx Advanced Concept Effectiveness Studies led to a Tentative Operational Requirement (TOR) and Development Options Paper for future close-in weapons systems (CIWS). The present CIWS is adequate, but compared to what will be needed in the year 2000 and beyond, it has deficiencies. Therefore, we have an ongoing project at Dahlgren to investigate the future requirements for the new CIWS. After months of analysis, we finally wrote a TOR that outlines all the top-level requirements necessary for this weapon to meet the future threat. The final product may not resemble anything we have in the fleet today.

We completed both static and dynamic testing with Focused Ordnance Simulating Devices (FOSDICs) to obtain damage data representative of a directional warhead. The FOSDIC, not a true warhead, is a special device constructed for such tests. Still in the exploratory development stage, the directional warhead is designed to concentrate the fragmentation pattern in one direction (toward the target), causing considerably more damage than a nondirectional warhead, which creates a symmetrical fragmentation pattern but with considerably less fragment density.

When the warhead target group studies target damage, they often use static arena tests where *stationary* warheads and targets are detonated and the damage recorded. To estimate the results of a dynamic engagement where the warhead and target are both *in motion*, mathematical formulas are used to calculate damage, taking into account the effect of the missile's forward velocity. In the dynamic tests conducted with FOSDIC, at around Mach 2.5, it appeared that current methods of using static

data in dynamic engagement simulations are reasonable.

Since October 1986, NSWC has been the Lead Laboratory for STANDARD Missile, a role that includes serving as design agent for the warheads. Among last year's major milestones, we completed a Conceptual Design Review (CoDR) for the EX 125 Warhead. The EX-125 will be an integral part of the SM-2 Block IIIA and IV missiles, providing enhanced performance and keeping pace with the ever-evolving threat. Concurrently, we began the Mk 115 Warhead Product Improvement Program. The major thrust of this program (for the Mod 1) was the replacement of the primary explosive. The new explosive, PBXW-113, eliminates the need for a sole-source primary ingredient, while maintaining the same level of lethality and insensitive munition performance.

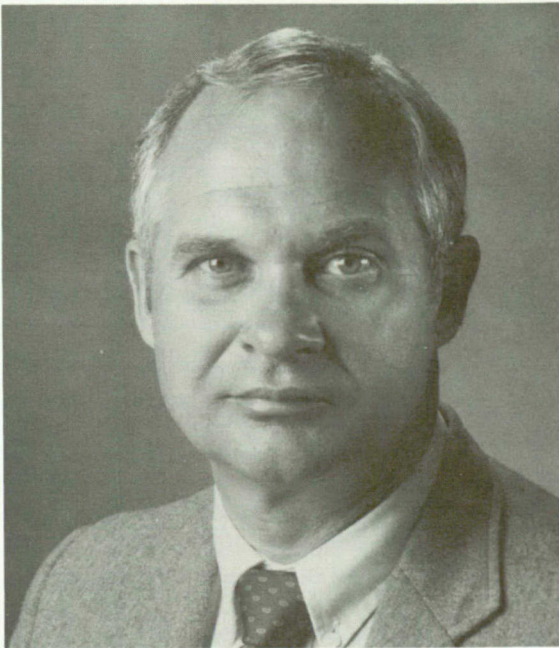
In the area of STANDARD Missile propulsion improvements, we tested a simulated booster for SM-2 Block IV. The purpose of the test was to achieve the maximum possible performance of the booster that would not require the redesign of the existing Vertical Launching System Gas Management System. The results of the test were extrapolated for use in the development of the specification for the actual Block IV Booster.

When looking at the present and future threat, our goal remains to fulfill the Navy's requirements for an optimum surface and air defense. We are taking a layered defense approach—which means you have an outer layer (for very long-range threats), a middle layer, and a point defense for countering threats that get very close to the ship. We learned from incidents like the USS *Stark* that all the sensors need to be integrated and the data from them successfully assimilated to adequately protect the ship. With better and quicker establishment of a firm track, we can counter the threat before it reaches the close-in range. The innovations in enemy offensive weapons spur us on to continue advancing the state of the art.

(Wallace Morton, William Elliott, and Charles Boyer contributed to this article.)

Weapons Systems Department Assessment

by Rodney L. Schmidt



Rodney L. Schmidt, Head, Weapons Systems Department (G).

The Weapons Systems Department—G Department—focuses its attention on the major weapons systems for the Navy from the standpoint of hardware and software developments, program management, and tech base. When we speak of G Department's efforts in surface warfare, we are actually talking about what will be employed in the fleet. We couldn't ask for more than that.

The major weapons systems on our surface warfare ships, specifically the AEGIS cruiser and destroyer, are the STANDARD Missile, the Vertical Launching System, and the AEGIS Weapons Control System. It is hard for me to conceive of a responsible surface warfare organization not having major responsibilities in the developments related to these systems; therefore, in 1987 we made a conscious decision to move the Weapons Control Division from N Department to G Department so that we could tie together the missile, the weapon control, and the launcher. Integrating these three areas

allowed us to have control over the total weapons system development.

In 1987, we became the Lead Laboratory for STANDARD Missile. We have primary responsibility for the SM-2 Block IV development, which is the AEGIS extended-range version. For the past 10 years, we have been responsible for designing the warhead, an area in which we will continue our expertise. We also ensure that all the major components of the missile work together.

We are the Technical Direction Agent for the Vertical Launch Program. We ensure the system interfaces with all the weapons that will be launched from it and that the software in the launcher system also interfaces with the other software systems on board any ship that will use the Vertical Launching System. In that area, we are currently concentrating on the AEGIS cruiser.

We are also developing the Mk 160 Mod 4 Gun Computing System, which is used in the AEGIS Gun Weapons System. I am very proud that G Department is the Design Agent for this effort. We are designing the computer system; in addition, we are the Technical Direction Agent in charge of the total development. We will also develop a modification of that system to be used on the battleship to control the 16-inch guns. This modification will go on the four battleships that are now active in the fleet. We have applied our expertise in software during development of the AEGIS Gun Weapon System. Should we lose any one of our experts during the design phase, our program would be affected. Someone new could not easily step into a crucial position at this stage of the program and have the program still meet the schedule requirements.

One of G Department's new programs in 1987 was the NATO AAW Program. The purpose of the NATO AAW Program is to develop a system that engages the missile threat close to the ship. We are the System Integration Agent for that program and are responsible for integrating the

electronic warfare system, the close-in gun system, and a missile system. Our responsibility is to develop the interfaces that will allow those subsystems to work together to combat low-flying cruise missiles or aircraft that penetrate the midrange engagement systems. The program is matrixed out to different organizations such as the Electronics Systems Department, other parts of G Department, and other naval facilities, such as the Naval Weapons Center, China Lake.

In 1987, we were designated Technical Direction Agent for the PHALANX Close-In Weapons System (CIWS), a new role for us, although we have been involved with CIWS for a few years. Currently, the staff is evaluating a concept for an advanced system, possibly one with higher-caliber projectiles.

An underlying thought we must keep in mind throughout the development of these programs is the crucial linkage between the laboratory and the sailor. We are responsible for developing a system that can be used by the sailor aboard the ship—one that is reliable, where the human interface to the system is made as simple as possible. We take into account things such as the location of the displays and controls so the sailor can operate them in an efficient fashion. During development, we actually have some of the sailors come in, look at the equipment, sit down in front of it, and use it. We solicit their

inputs and comments and incorporate them in the final design.

Our people are welcomed aboard ship. We have the responsibility of going to sea to ensure that the part of the system we design operates, as planned, with the rest of the system. Our people work directly with the sailors, as the equipment is being installed and tested. We find our engineers and the “black shoe” Navy community have a good working relationship. On occasion a ship will request NSWC employees by name to come and assist with technical problems. We know the people who use the system we develop have confidence in us. The ships have to use what we develop, and we know they need the best to perform their mission. We aim to give it to them.

Our future in weapons systems looks promising. The Navy is evaluating the potential of systems to replace guns and even the potential for systems to replace missiles. In the future, we will be concentrating on the development of directed-energy systems. The Electronics Systems Department (F), along with the Research and Technology Department (R), is conducting research associated with directed energy. We will support them in the weaponization. We are evaluating new weapons concepts. We plan to shift away from some of our past responsibilities and develop what will be needed 20 to 30 years from now to defend our ships.

Protection Systems Department Accomplishments

by Roy Shank



Roy Shank, Deputy Head, Protection Systems Department (H02).

NSWC's Protection Department (H) leads the Navy in the areas its scientists and engineers address: systems safety, magnetic silencing, chemical warfare defense, and electromagnetic/nuclear effects. We specialize, not in damage control, but in the design of ship survivability. Our 1987 accomplishments extended our reputation that we are number one in the protection R&D we do.

Last year, our scientists and engineers provided key support in Solid Shield '87, a chemical warfare defense, joint service exercise. In a leadership role, NSWC evaluated how the fleet responded to simulated chemical warfare attacks. The exercise employed detectable simulants so that the ship's level of contamination could be measured as well as the crew's success in the clean-up. Many of our chemical warfare experts attended, evaluating the preparedness of the fleet and providing instruction on how to deal with a chemical attack.

In support of radiation hardening of ship-launched tactical missiles, our personnel installed and initiated operation of the Tactical Gamma Ray Simulation (TAGS) facility, which provides the Navy with an important atmosphere in which to expose weapons and weapon components to gamma radiation. One of the products of a nuclear explosion, gamma rays can burn out the weapons and the electronic components in a weapon system, rendering them useless, and the ship defenseless. TAGS generates gamma rays, allowing us to test components to see if they have been hardened (protected) enough, or whether they will indeed burn out. This facility allowed us to experiment, in a safe environment, with improving our components to withstand the effects of a nuclear burst.

In 1987, we transferred the responsibility for the Magazine Security System Mk 1 to the Naval Ordnance Station, Louisville, without any program slips. Years ago, NSWC decided that it would divest itself of this effort. We planned and executed a smooth transition of that program. As parts of the project reached a level of accomplishment where the design was well developed, we handed off the responsibility for the follow-through to Louisville. Now NOS is preparing for the production phase, all the way to the introduction of the system into the fleet. The Navy, trusting the reliability of our design work, allowed us to slowly divest the production side of this program.

We made significant advances in the development and testing of a new ablative composite for use on guided-missile launchers. When a missile fires, the exhaust impinges in a plenum and is then released in controlled amounts. The contents of the hot blast can grind off surfaces. Within the plenum, or any place where the exhaust impinges, the surfaces are coated with ablative materials that burn away, protecting the ship's structure, much like the shield in front of a spacecraft burns away when the capsule re-enters the earth's atmosphere.

The biggest setback that occurred was the result of a 1986 decision to divest ourselves of

the chemical warfare effort. We began the divestiture process; the personnel began to look for other jobs; and the lab quickly lost capability in this area. Then the decision to divest was reversed. As the Navy's only agency specializing in chemical warfare defense for surface ships, NSWC had to stay in the business. Two more years will probably pass before we are fully recovered, regaining the personnel and expertise we had, to accomplish this specialized type of work.

The most important on-going project in the Protection Systems Department (H) is our efforts in closed-loop degaussing. Normally, a ship carries a degaussing coil, a coil of wires, within its hull, which are energized to counter or try to nullify the ship's magnetic signature, reducing its vulnerability to magnetic-sensing mines. With regular degaussing coils, the ship periodically enters a facility that measures the magnetic signature and sets the amount of current going through the coils to reduce the magnetic field as much as possible. Over time, and as the ship goes through various maneuvers, the minimization decays and the magnetic signature grows, until it is adjusted again. With closed-loop degaussing, the ship senses its own magnetic field while it is underway and continually adjusts the current flowing through those coils to achieve a minimum signature at all times.

At White Oak, the Magnetics Field Branch (H32) developed a computer simulation and experimentally proved it with a laboratory model. A very important step for the Navy's magnetic silencing efforts, I expect this will have a large impact on the way we design and build ships and submarines. H32 personnel worked on a minesweeper as a first prototype for the closed-loop degaussing system. The Navy may or may not backfit this system on existing ships,

depending on the cost, but I am sure it will be in new ship designs.

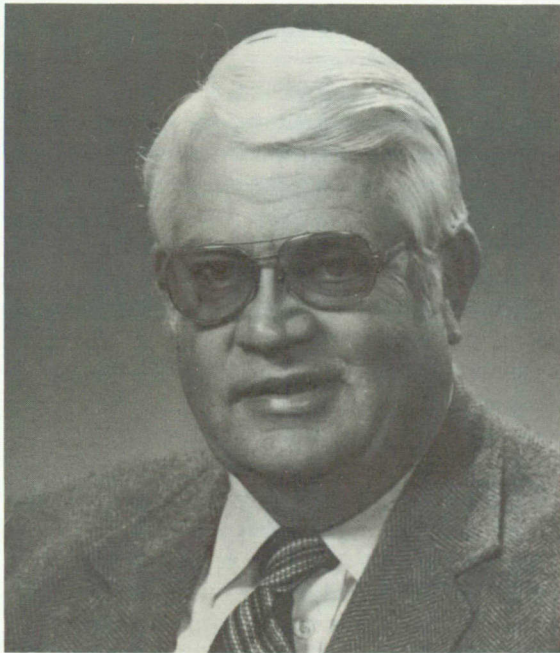
In 1987, we changed our emphasis somewhat, from solving the problems that exist in the fleet after the hardware has been deployed, to trying to anticipate problems in the early design stages. As part of the strategic direction within the department, this emphasis will be growing in the future.

Our scientists and engineers continued to do a variety of work in the protection arena to strengthen the defense of the fleet. Our Shipboard Nuclear Weapons Security Program created a new system to protect the nuclear weapons onboard ship. In the electromagnetic environments effects (E3) field, we solved problems for the fleet, protecting explosive devices and weapons that would be ignited by the RF energy in a shipboard-type environment. We also studied the many electromagnetic effects of radio pulses and radiation on hardware. The protective hardening of fleet systems assures the survivability of our fighting capability in the event of a nuclear attack.

We measure our success by the number of problems we solved. Each area is a little different; progress in chemical warfare and magnetic silencing is measured by what we transition to the fleet; nuclear safety, by how well the components pass their safety requirements; and nuclear effects, by the number of weapons we are testing and hardening. Fleet problems requiring immediate attention are measured by the turn-around time, the analysis of the difficulty, and our ability to generate a solution that is operational aboard ship. The Navy looks to us for our expertise in all these areas. By their and our standards, we made 1987 a very successful year.

Protection Systems Department Assessment

by Robert T. Ryland, Jr.



Robert T. Ryland, Jr., Head, Protection Systems Department (H).

I'm very proud of the Protection Systems Department's accomplishments in 1987. We are rebuilding those areas where we had serious cuts last year and are now approaching normal. We have highly dedicated people here who are unique experts in their fields and who have a direct impact on the fleet. I am impressed by the technical depth of the work they do. It is very interesting and down to earth.

The primary thrust of the Protection Systems Department—H Department—is to design survivability into the fleet. Historically, much of the protection efforts have been reactionary—responding to accidents, nonperformance of systems, or testing and analysis of complete systems. In 1987, we began to focus our efforts toward being more pro-active and anticipatory. We aim to have more impact at the engineering development phases of systems evolution through the provision of design tools and standards and through direct engineering involvement.

Although this emphasis on front-end design should reduce the need for fixes on completed systems, it will not, by any means, eliminate them. Therefore, a need continues for systems testing and direct fleet support, including quick-response action, such as the recent electromagnetic activities in support of Persian Gulf operations. On very short notice, **Bill Lenzi**, **Ben Franklin**, and other HERO (Hazards of Electromagnetic Radiation to Ordnance) and EMV (Electromagnetic Vulnerability) people were significant contributors to the peace-keeping exercises in the Persian Gulf.

We are continuing to build emphasis on software safety, a vital factor affecting the safety of our sailors. **Mike Brown's** tri-service leadership enhances that area. The software safety area is highly significant, with more and more naval systems being software-dependent.

We have done a substantial amount of work in TOMAHAWK missile safety, impacting the design of some of the hardware there. **J.B. Gessler** has been responsible for much of that.

Larry Jackson and his people provided substantial support to the Navy Weapons System Safety Review Board. **Glen Moore**, **Chuck Boyer**, and **George Soo-Hoo** have made significant contributions in analysis and design of missile launcher systems and research into the thermal and mechanical effects of exhaust gases.

Through the work of **Jon Yagla** and others, we have improved the accuracy of the 16-inch guns, particularly through control of the firing sequence.

In the nuclear and electromagnetic world, one of the important programs that hold a lot of promise is the nuclear war gaming work that **Ed Kobee** has done. The work involves modeling tactical nuclear warfare tactics, and thus increasing awareness of nuclear warfare at sea and how to best deal with this possibility.

Another thing we are proud of is the recent development and introduction of the TAGS facility—Tactical Gamma Ray Simulator—which is a major facility for measuring the radiation effect on missiles from gamma rays. **Andy Smith** and **Van Kenyon** are primarily responsible for that facility, which was created at very low cost from an unused segment of the CASINO system.

One technical area in which we are involved, due to the technical background of our people, but which is not within our primary mission, is charged-particle beam steering. **Gene Nolting** has been very instrumental in the first demonstration of the capability of steering charged-particle beams and also measurement of secondary radiation from the propagated beam.

In the ship electromagnetic compatibility (EMC) area, we have solved many fleet problems. We are looking into doing future work in battle force frequency management in the EMC area. **Chris Hontgas** and his people have been responsible for that area.

We have also given major technical support for development of EMPRESS II, the EMP simulator that will be able to test ships at threat levels. **George Brackett** heads that program.

One of the most significant happenings in the survivability area is the work in advanced magnetic silencing, performed by **John Holmes**, **Milt Lackey**, and others. The lead item here is the Closed-Loop Degaussing System that will enable ships to reduce their magnetic signature at sea without having to come in for a range measurement. We have also done considerable work in magnetic range improvement at the King's Bay TRIDENT Base. **Jim Miller** and **Rob Wingo** are largely responsible for that.

The year brought progress in understanding problems with chemical defense equipment and procedures, including substantial participation in fleet exercises, such as SOLID SHIELD. **Andy Byrne** and others in the Chemical Warfare group contributed heavily here. They were also

responsible for increasing fleet awareness of the problems in this area.

In 1987, **Joe Brumfield** and his branch evaluated new chemical warfare threats, one of the keys to rejuvenating the chemical warfare capability.

I am also very proud of the survivability analysis we did on USS *Stark* in 1987. We were part of the Navy team that went out to the ship to discover the lessons to be learned from that incident. **John Nelson** was one of the key persons involved in damage assessment.

The biggest obstacle during 1987, particularly the last part of the year, was the vague, uncertain Navy budget. Our programs were significantly impacted by the uncertainty in the budget and problems in getting the necessary planning from the program managers uptown. These problems are beginning to level out now.

Certainly, to a smaller extent, there were some residual effects from the earlier decision to divest the chemical warfare business. However, we are now getting back to normal in this area due to the corporate decision to rebuild that business back to a viable level. One of the positive influences here is the assessment of new threats in the chemical warfare area, which will mean more tech base work in the future and eventually more development work to counter those threats.

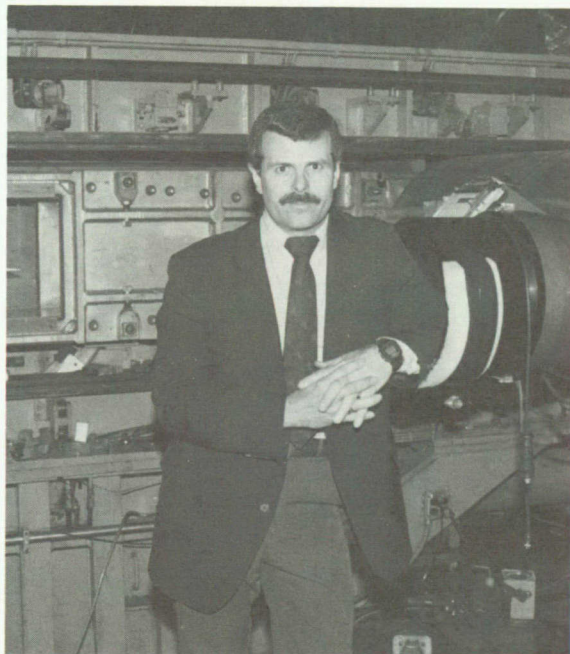
The future looks good. As I previously stated, we plan to devote more attention to building our software safety work. We will move toward more front-end design impact in the electromagnetic area and also in the nuclear protection area. We plan to continue to rebuild the chemical defense effort to reach a viable level, and will continue to develop and explore advanced magnetic silencing technology, including the closed-loop degaussing work. We will, of course, complete the phase-out of the Ship Nuclear Weapons Security (SNWS) work by about the end of 1991.

In summary, rather than seeking new leadership roles and broad new areas of work, our goal is to become better in those critical areas where we already have competence and leadership responsibility, and to adapt to the changing surface warfare environment, including new threats. We will continue to fix problems in the fleet as they inevitably occur but will put more emphasis on long-term reduction in fixes by better front-end design.

Strategic Systems Department

Accomplishments—Future Re-entry Systems

by Dr. Alfred M. Morrison



Dr. Alfred M. Morrison, Chief, Re-entry Engineer, Weapons Dynamics Division (K20).

NSWC re-entry activities in 1987 focused on the transition of the D-5/Mk 5 Re-entry System for TRIDENT II, from the final stages of full-scale development to preparation for production and initial operational capability. We developed and verified the analytic tools for assessing operational test performance, and completed final qualifications of production manufacturing hardware (previously developed by NSWC). We also completed analytic studies aimed at defining future SLBM re-entry systems.

Shape-stable nosetips manufactured on the NSWC-developed automated weaving machine successfully completed extensive flight and ground tests. The Strategic Systems Project Office and Lockheed Missiles and Space Company certified the production documentation. The NSWC machine is currently producing TRIDENT II hardware. A second automated weaving machine was built to NSWC specifications—intended to operate concurrently

with the first in a single operation, for an additional saving.

We developed an accuracy simulation for the TRIDENT II D-5 Mk 5 re-entry body, based on the physics of dynamic behavior during re-entry flight through the atmosphere. We're making predictions with this simulation of the expected (nominal) and statistical (random) behavior of the instrumented test re-entry bodies in the D-5X flight tests. It seems useful in identifying root causes of observed flight behavior, and we expect ultimate capability for extrapolating re-entry body flight performance to conditions for which there is little or no flight test experience.

We're investigating the aerodynamic characteristics that a maneuvering re-entry body (MaRB) requires in order to penetrate enemy defenses. These aerodynamic characteristics are described in terms of basic attributes, such as lift, drag, and ballistic coefficient, rather than by external MaRB shapes, so that a large number of parametric combinations can be evaluated quickly. The defense attributes (the antiballistic missile capabilities) vary from those demonstrated to those possible some twenty years hence, and the defense modeling considers optimal use of resources. We expect future contribution to MaRB design from this work.

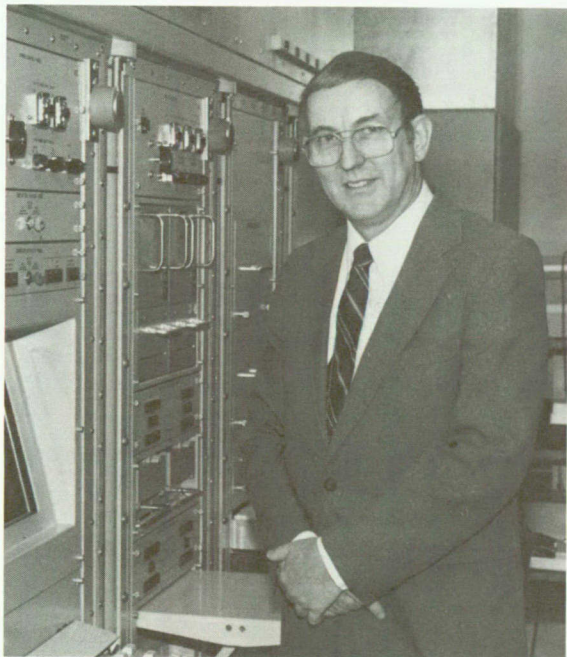
We're also doing work to determine potential SLBM re-entry system requirements and interfaces for the deployment of an Earth Penetrating Weapon (EPW)—capable of destroying buried hard targets. The year 1987 saw a resulting proposal for an EPW Advanced Development Program and presentations on our understanding of this potential given to various Navy and DOD organizations, toward a possible FY89 start. Such a start is uncertain at this time.

This re-entry (hypersonic) science and engineering capability at NSWC, backed by the unique hypersonic ground test (wind tunnel) facility, gained increased recognition in 1987 for quality and potential contributions to future aerospace systems.

Strategic Systems Department

Accomplishments—Future Strategic Systems

by Raymond H. Hughey, Jr.



Raymond H. Hughey, Jr., Assistant Head for SLBM, Strategic Systems Department (K07).

Prior to 1987, the work at NSWC investigating concepts for weapons to follow the TRIDENT II D-5 system received very little interest outside the small group directly involved. Sometimes we seemed just “whistling in the dark.” However, as the D-5 proceeded smoothly through development during 1987, interest in future strategic systems picked up sharply at all levels within the Navy. We became involved in dialogue with almost all Navy offices concerned with strategic systems—as key players in developing and exploring concepts for both offensive and defensive strategic systems.

Potential offensive systems include both modifications and upgrades to the TRIDENT II D-5 system and also completely new systems. The thrust of this work has been to assure continued deterrence by holding at risk all critical enemy strategic targets, in spite of countermeasures they have now or are expected to have. The effort concentrates on penetrating

missile defense systems, destroying hard (and very hard) targets, and targeting relocatable and mobile targets, all while maintaining or improving the security of the submerged offensive system at sea.

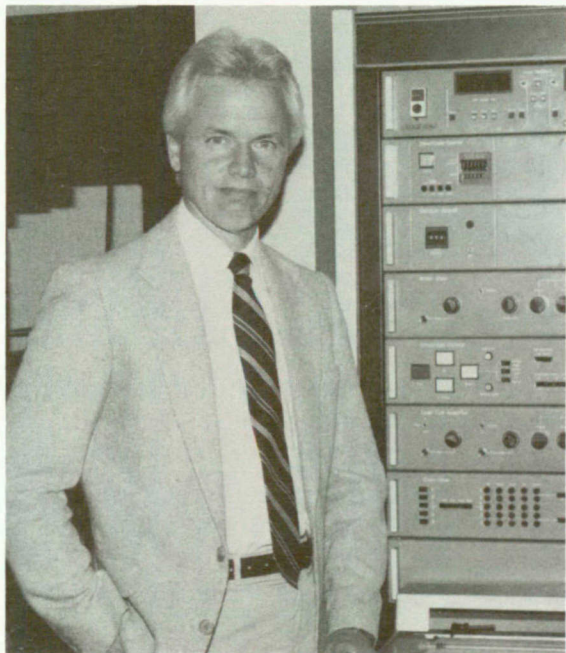
NSWC participated in several studies to examine the strategic defensive role for sea-based systems. The jury is still out, at year end, on whether the technology base, political situation, and economic factors indicate fielding a strategic defense system in the 1990's is the right thing to do. However, it is clear to me that if the nation does elect to build such a system, part of it should be sea-based. The forward basing available at sea allows a good shot at enemy ballistic missiles in their boost/post boost phases of flight—thereby eliminating several re-entry vehicles with a single defensive weapon. The capability to remain on station, providing continuous coverage of designated patrol areas, gives a much higher presence factor than can be achieved with space-based weapons. Of course, there's a lot more to this story, but these considerations together with mobility and security (especially for submerged platforms) present the Navy with potential system capabilities that cannot be matched by ground and space-based approaches.

This 1987 system concept exploration, continuing in 1988, forms the base for research and development in the next decade, toward acquiring the next generation of Navy strategic weapons systems, both offensive and defensive. This year we laid the foundation for many years of exciting and fulfilling work for the strategic systems community.

Strategic Systems Department

Accomplishments—Future Weapons Materials

by Dr. William T. Messick



Dr. William T. Messick, Weapons Materials Technology Manager, Weapons Dynamics Division (K205).

Metal-Matrix Composite (MMC) instrument covers for the TRIDENT II Mark 6 Guidance System were flight tested for the first time in 1987. This success makes the silicon carbide/aluminum version the baseline for this component, which will cost 50 percent less than the previously selected beryllium item. This transition from the Weapons and Spacecraft Materials Technology Block Program adds to several previous contributions to TRIDENT II.

In another 1987 materials achievement, a new midwavelength infrared dome material was developed for Advanced STANDARD Missile applications. This material, an undoped yttria, has much higher use temperature over the entire 3- to 5-micron band than current materials, so that higher missile intercept velocities are now possible.

Having been responsible for major systems performance improvements and significant cost

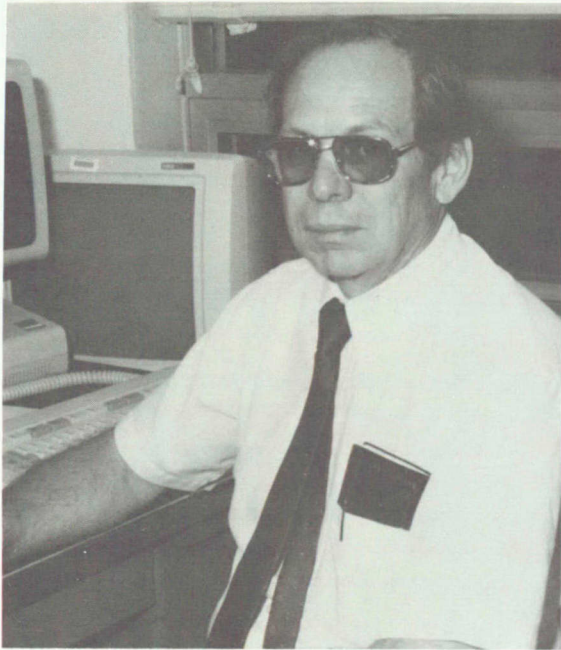
saving on several individual components for TRIDENT II, the NSWC expertise in carbon-carbon and metal-matrix composites developed in Technology Block programs is now being applied to other Navy systems. An example is for survivable spacecraft structures, where significant technical progress is showing in lightweight structural and thermal management materials. Another example is metal-matrix torpedo components being considered for fleet introduction to save weight. We began a study to quantify the cost saving from use of metal-matrix missile fins, and also started work on carbon-carbon engine components for turbine engines. Recent investments in ceramics are leading to significant advances not only in infrared domes but also in hypersonic radome materials and high-temperature, survivable propulsion and structural components.

It seems that we're on the right track with our management and conduct of weapons materials technology work. This program is solidly anchored at both ends—in a competent in-house research and technology capability, and in various competent industrial sources of production technology.

Strategic Systems Department

Accomplishments—Future Space Systems

by Robert W. Hill



Robert W. Hill, Office of Space Technology and Systems Applications (K107).

Chief of Naval Operations Admiral Carlisle A. H. Trost made clear in an October speech what space means to the Navy. "For our Navy, whose operating environment covers three-quarters of the surface of the world, space is indispensable to the successful execution of our national maritime strategy and thus of our national military strategy," he said, adding, "...our Navy simply must have space on its side to be able to fight effectively."

We have aligned our own NSWC "space thrust" with this simple truth, looking for space-related research and development (R&D) where the special talents of NSWC people can make a difference.

Our MARS (Missile Attack Response Simulator), was a primary asset to understand threat cloud characteristics (from a massive ballistic missile attack), and thereby assist the strategic defense architecture. But the Strategic Defense Initiative Organization (SDIO) turned down the Navy idea to use MARS in the National Test Bed (NTB). So we put MARS to

use for Navy roles in strategic defense, and adapted the MARS approach for a multiwarfare simulation embedded in a distributed processing network, to support the Warfare Systems Architecture and Engineering (WSA&E) initiative of the Space and Naval Warfare Systems Command (SPAWAR). This 1987 evolving capability is called Attack and Defense of Maritime Resources in Adverse Locales, or ADMRALS.

A major breakthrough occurred in 1987 for processing satellite altimeter data—used to determine ocean tides and other dynamic ocean effects such as currents and eddies. Dr. Ernst Schwiderski applied modern matrix operations in a new way to give unprecedented resolution and quality—solving a twelve-year-old problem of dealing with large matrix computations. This mathematical achievement gained immediate interest from scientists around the world—an important step forward in using satellite altimetry to increase our knowledge of the world's oceans.

Satellites can be both an asset (to us) and a target (to an enemy), and vice-versa. The more important or critical a function space systems would play in warfare, the more likely they would become involved in that warfare as targets, and possibly be destroyed. This introduces survivable satellite "reconstitution" as a requirement, as well as antisatellite countermeasures to such reconstitution by an enemy. We've contributed this year to Navy understanding of the technology and systems possibilities.

We've also contributed in 1987 to other CNO space goals, for capability and flexibility in space systems. A space system using cooperating tracking and intelligence-gathering satellites was proposed to extend the Surface Force "battle horizon" to a thousand miles or more. NSWC analyzed the battle management impacts for Antisurface and Antiair Warfare, designed an integrated simulation concept putting overhead tracking into the Battle Force picture, added considerations in the ADMRALS development, and related the proposal to the state of the art.

Strategic Systems Department Assessment

by David B. Colby



David B. Colby, Head, Strategic Systems Department (K).

Nineteen hundred eighty-seven was another year to praise the outstanding efforts of Navy scientific and engineering people in space and strategic systems work and its supporting technology base at NSWC. This year threw unusual challenges at the technical team in the Strategic Systems Department at Dahlgren and White Oak, and the scientists in the Research & Technology Department at White Oak—from an external environment of budget deferrals and cuts, much programmatic turmoil, retrenchment decisions, leadership changes, and a hiring freeze late in the year. The team seemed to know the right things to do, “shifted gears,” so to speak, and drove over the obstacles, in just about every work area.

Despite these extra challenges (beyond the difficulty and complexity of the R&D work itself), our fire-control software, direct communications linkage, and on-scene support assisted eight straight successful developmental flights of the TRIDENT II D-5X missile in 1987,

from Pad 46A at Cape Canaveral, Fla. And the in-house development team also met every other TRIDENT II product delivery milestone, internally and externally, in 1987. These include the first TRIDENT II D-5 fire-control software specifically for submarine use—to General Dynamics Electric Boat Division in December to support the USS *Tennessee* (SSN 734) installation; and to General Electric Ordnance Systems Division at the TRIDENT Training Facility, Kings Bay, Ga., to support the simulation environment there. Other diverse deliveries included the preliminary targeting models to the Joint Strategic Targeting Staff (JSTPS) and their contractors, to enable applying TRIDENT II to the target base; and a second qualified automated weaving machine for making shape-stable nosetips, increasing the cost saving to the TRIDENT II program.

Despite final rejection of our MARS (Missile Attack Response Simulator—previously recommended by the Navy) by the Strategic Defense Initiative Office (SDIO) for use in their National Test Bed (NTB), we found this validated family of tools useful to evaluate potential naval roles in strategic defense, and adapted the general methodology to the multi-warfare battle management situation for Naval Surface Forces—in an approach called ADMRALS (Attack and Defense of Maritime Resources in Adverse Locales). This effort became a large part of NSWC’s direct support of the Space and Naval Warfare Systems Command’s priority thrust in Warfare Systems Architecture & Engineering (WSA&E).

Despite loss of most of our R&D program from the Defense Mapping Agency (DMA), we excited a worldwide community with a breakthrough in analysis of satellite altimeter data, delivered on previously promised products, and negotiated a new programmatic understanding with DMA to keep alive this space-related R&D effort. And DMA selected an NSWC scientist for a 1987 R&D Award.

Despite a major restructuring of the Weapons & Spacecraft Materials Technology Block Program due to congressional budget cuts, we

successfully transitioned a Metal-Matrix Composite (MMC) component for the TRIDENT II Mk 6 Guidance System—this new baseline means a 50-percent cost saving over the previously selected component—and developed a new infrared seeker dome material for advanced missile applications. This, while moving the advanced materials expertise at NSWC toward more applications as diverse as torpedoes and spacecraft.

Despite the overall uncertainty in new DOD missions and programs for strategic offense and defense, we led critical Navy studies of sea-based approaches to emerging strategic needs. The quality of these studies seems, at year end, to be gaining both understanding and proponents—setting the stage for the next decades of R&D and new capabilities appropriate to the new national security tasks. The uncertainties and their priorities made advance planning more difficult for NSWC as a whole, however, as the Center tried to plan a strengthening of its Surface Warfare contributions over the next ten years.

Despite wild fluctuation in external funding, scheduling, and preparation for R&D “ground tests” in our hypersonic wind-tunnel facility, a useful hypersonic R&D year was recovered by energetic re-planning and exceptional technical and managerial negotiation. As a result, feasible R&D schedules for multiple sponsors were restored, and the stage set for important contributions to such major technology efforts as the National AeroSpace Plane (NASP) program. And we also advanced the state of the art in instrumentation for wind-tunnel research along the way—often with special contributions from the Engineering Department.

Despite the decreasing limits of capital investment financing for minor construction and equipment, we delivered Centerwide data telecommunications, office automation, and computing capability—with significant upgrades and new applications, while preserving options for decisions in 1988 on structure for Computing and Information Systems organization. Work in

1987 confirmed some essential elements of the future Centerwide system at NSWC, involving both large-scale central clusters and distributed work stations and networks, in an evolution toward more end-user computing and departmental computing. The emergence of separate mandated information systems for functions such as financial, procurement, personnel, and public works operations—all centrally but independently developed over a period of years, for common use across diverse Navy activities—presented a serious and unsolved problem for NSWC (and other Navy R&D commands) where these systems must all operate together. Most don’t even work well as stand-alone capabilities yet, and the larger developments such as STAFS (Standard Automated Financial System) seemed, at year end, to promise only more cost and delay to usability.

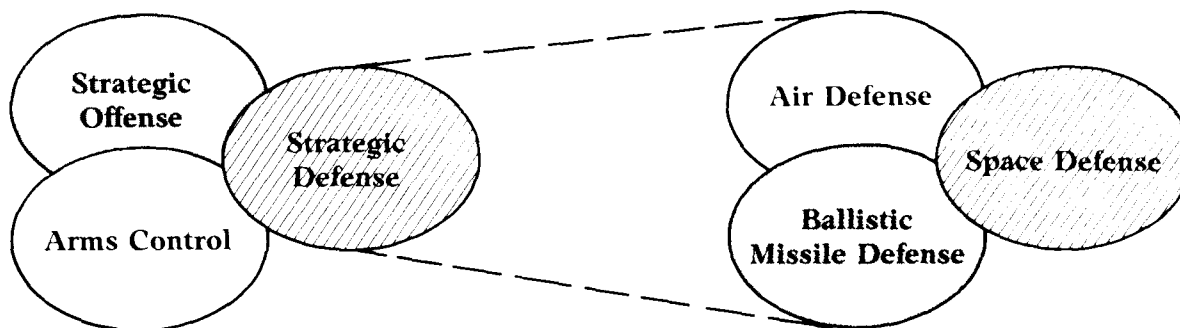
And despite all these clear and present dangers in 1987, and all the on-going work to get done, strategic systems people also attacked some dormant but central technical and systems problems in future strategic warfare—such as what technology and concepts would enable the U.S. to hold all critical enemy targets at risk, despite possible countermeasures. For this problem we led a complete rethinking of concepts of operations for strategic offensive forces—with the product available in December for SECNAV and SECDEF review.

So, what does this 1987 picture of Strategic Systems at NSWC mean? This was the year we began to understand the relationship among the different parts of national security at the strategic level—(1) the strategic offense, (2) strategic arms control, and (3) the strategic defense. This was the year we began to understand the different but related parts of strategic defense—(a) ballistic missile defense, (b) space defense, and (c) air defense (see accompanying illustration)—and the technical and geographic truths that would underlie cost and performance in those missions. This was the year we began connecting the space-related work at NSWC to the future of the Surface

Navy. This was the year the Navy and others recognized our understandings—and we accepted the leadership roles (and risks) to define technology and concepts for new Navy missions with special advantages for national security at the strategic level. And this was also the year

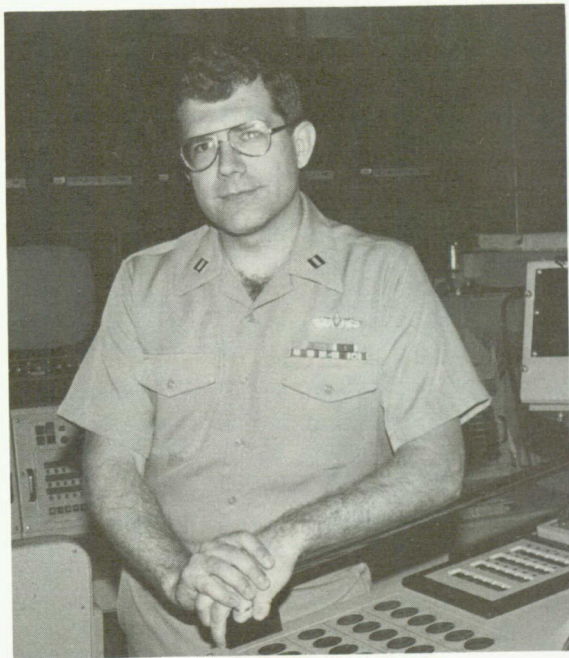
we began a substantial increase in our contribution to the technology base.

1987—a year to be proud of people at NSWC doing strategic systems.



Combat Systems Department Accomplishments

by LT Lee Bond, USN



LT Lee Bond, USN, Combat Systems Laboratory Project Office, Combat Systems Department (N04).

Installing the Shipboard Gridlock System (SGS) Baseline 2.0. software aboard USS *Bunker Hill* (CG-52) marked a very important accomplishment in 1987. For effective battle group defense, naval personnel need an exact geographical fix on where all their allies and adversaries are, seen and unseen. Crucial to any individual ship, SGS enables the commanding officer to know with a higher degree of certainty than he ever had before that his location information is accurate.

Taking this a step further, he can now exchange information with enough precision to assist other ships in locking onto incoming threats. Formerly, when the CO gave another ship a "heads-up" to prepare for a threat, the defending ship still had to acquire the target with its own radar before it could aim its weapons because the information from the remote source was not accurate enough to target the threat. Now, a missile shooter can, if necessary, engage another ship's target without

ever bringing his own search radar to bear. This allows the commander, in battle group defense, to quickly choose the best sensor and weapon to train on the target, selecting each from among the surrounding combatants.

We passed two significant milestones with TOMAHAWK in 1987. First, we delivered and installed the AN/SWG-3 Block I Weapon Control software on *Bunker Hill* and USS *Spruance* (DD-93), the first ships of their class configured with the Mk 41 Vertical Launching System (VLS). *Bunker Hill* represents the first VLS/AEGIS cruiser where TOMAHAWK and AEGIS coexist, integrated on the same platform. In 1986, we successfully installed the AEGIS system on the ship and made it fully functional; in 1987, we succeeded in getting the AEGIS system to work with TOMAHAWK.

Because the TOMAHAWK missile resides in the same magazine as all the other primary weapons, we needed this software to prioritize which targets to shoot at, say in an AAW or ASW scenario, and select which missiles to fire from that magazine. This present degree of system integration transcends everything we had previously accomplished in this area. For any of this to happen, the AEGIS team had to do its job first, implementing the VLS variant of STANDARD Missile, before the TOMAHAWK installation could take place. The AEGIS and TOMAHAWK teams deserve a great deal of credit for the total integration of the platform.

Second, the TOMAHAWK AN/SWG-2 Block 2 Weapon Control System software was certified and CNO authorized its deployment on Armored Box Launcher-configured battleships and nuclear cruisers. The program translates the information from the targeting database into a firing solution (trajectory path) and then passes that order to the launcher. This weapon control system represents the state-of-the-art TOMAHAWK for battleships and cruisers without a combat system as sophisticated as AEGIS. It proves that keeping TOMAHAWK as advanced as possible on non-AEGIS ships remains vitally important to the Navy.

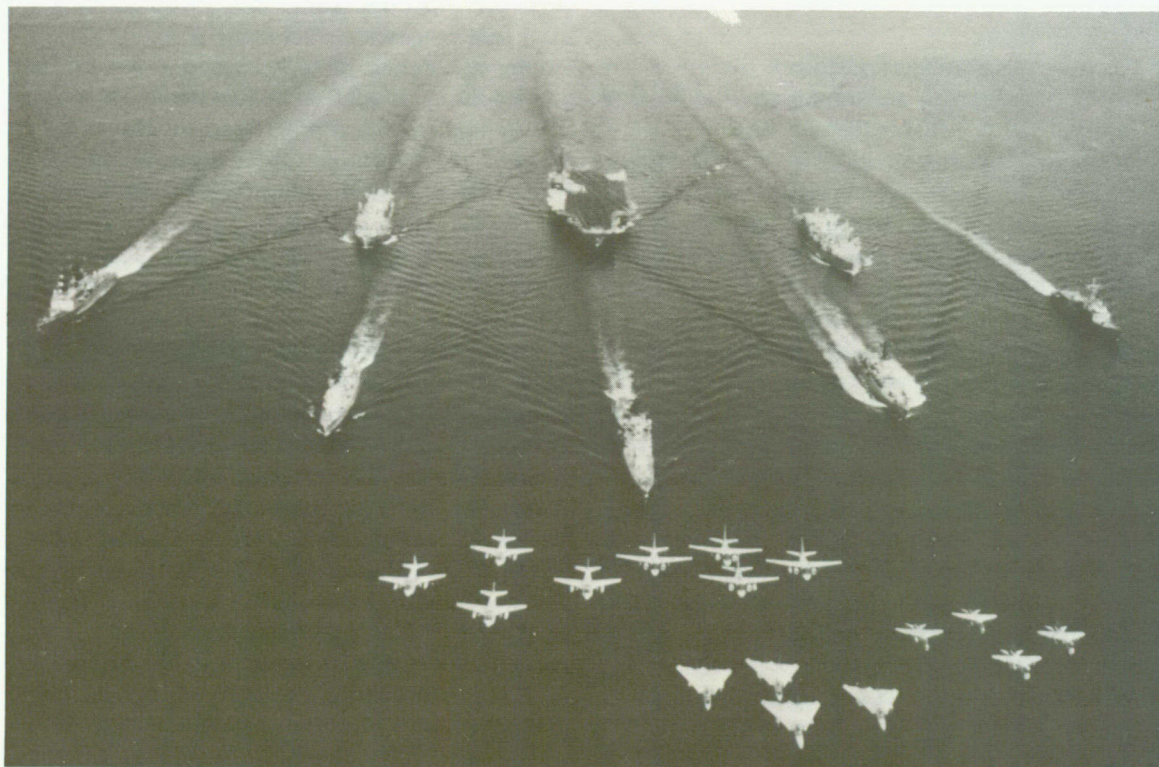
The development of CASANDRA, an artificial intelligence computer program that can automatically generate data reduction and analysis programs from high-level user specifications, represents a big technological leap. Its significance lies in providing the user with a common framework wherein all data extraction and reduction programs can be operated, while guaranteeing a common superset of information. This development impresses me particularly because this software technology is entirely new, not an upgraded version of anything extant.

In 1987, the Combat Systems Department expanded to include the Warfare Systems Architecture and Engineering (WSA&E) Project Office (N06), which coordinates some of the Center's senior talent from various areas (weapons systems, combat systems, etc.) and brings all their different viewpoints to bear to assist SPAWAR in force-level architecture development. Once the warfare systems

engineers define that framework, the next step is to examine how specific systems can be built and fielded within this larger context.

This "extra loop"—seeing the bigger picture—has challenged us to look at our work in a different way. We've ceased building pieces to put together a platform, per se, and have taken the opposite approach: working top-down from a complex war-fighting problem and defining how each component meshes with other components and systems on all the surrounding ships. This has required that the engineers and scientists, many of whom have been working in the same area of specialization for years, take into account how a component's function in a bigger context alters its research and development.

Exiting the era where the 16-inch guns at the Dahlgren river range were the sine qua non of surface weaponry, we've looked into new places to test our weapons systems. Performing tests at



Ships and planes forming a battle group.

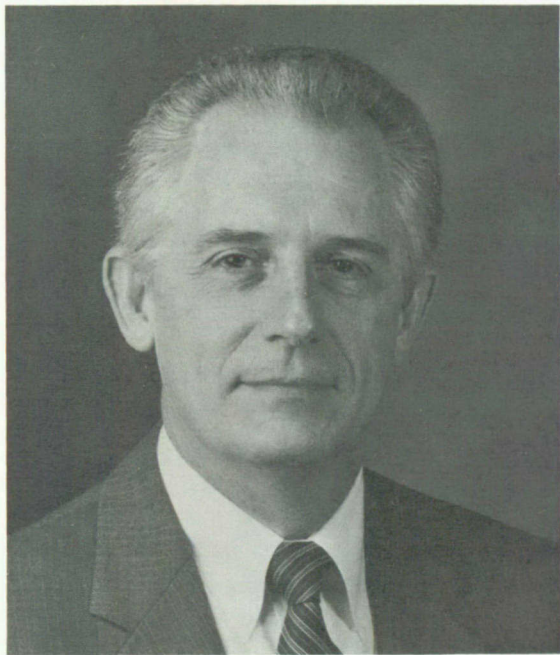
White Sands Missile Range, for example, we observed missile performance over the desert, but the Navy still needed an environment where our sensors could interact with the sea's natural elements, such as water reflection. Consequently, we looked at the available real estate and chose Wallops Island, Va. We initially planned to build a complete battle group on the beach representing all its component hull types, but budget requirements have necessitated a more economic approach. We have put an AEGIS facility in place that includes cruiser and (soon) destroyer functions. The next step is to build a force-level carrier facility with its various command and control systems. All the

key pieces will thus be there for the battle group of the year 2000, allowing us to set up procedures to test our integrated systems.

In 1987, we had many important upgrades in our systems, improvements that indicated where the Center and the Navy are headed: combat systems components integrated with command and control and weapons on platforms which, in turn, will be integrated with other platforms. This concept influenced the basic design of our components in unprecedented ways. The year 1987 showcased, more so than in previous years, the future thrust of the Center's R&D efforts.

Combat Systems Department Assessment

by Carlton W. Duke, Jr.



Carlton W. Duke, Jr., Head, Combat Systems Department (N).

The projects of the Combat Systems Department (N) cover the entire spectrum—all the way from ongoing research items to products going out the door directly to the fleet. We are a good illustration of how NSWC as a whole operates in a “full-spectrum” mode. In fact, we executed a broad mix of programs in 1987—ranging from tech base to operational support—and that’s the real strength of the department.

I’m reluctant to single out any ongoing task, project, or piece of work and point to it as the most important activity in 1987 that has had the greatest impact on the Navy. Each in its own way has or is having a significant impact. Who’s to say that AEGIS is more important than TOMAHAWK? Each contributes in its own way. Who’s to say that those fleet products are more important than some fundamental research going on in local area networks for imbedded systems or in the new evolving world of Warfare

Systems Architecture and Engineering (WSA&E)?

TOMAHAWK and AEGIS remain two of the mainstay programs of our department. There is a lot of strength in large, well-funded programs. From those programs, the people base and money base evolve, providing us with the opportunity for the training of people we need for the future and giving us the flexibility that allows research that will benefit the Navy. A misconception of our large programs, which at NSWC tend to be software intensive, is that they are nothing but life-cycle support. The truth is, in those programs there are always new thrusts of a fundamental R&D nature. For example, TOMAHAWK is now looking at a new, advanced cruise missile and a new afloat planning system. The latter will allow TOMAHAWK ships to retarget while at sea, something they haven’t been able to do in the past. The AEGIS program has embarked on the modernization of the first generation of its ships, and at coordination between AEGIS and non-AEGIS ships in a cooperative engagement mode.

Speaking of the new, the department is playing a major role in the WSA&E Program. Within the department, we have designated the Combat Systems Engineering and Assessment Division (N10) to be responsible for Warfare Systems Architecture, and the Combat Systems Engineering and Technology Division (N30) to be responsible for Warfare Systems Engineering. These two areas represent where the Navy is headed in the future. I am really excited and proud of the role we will play in this effort.

Looking to some of our other programs, we see good prospects for working more with some of the other R&D Centers—not only in WSA&E but in the Revolution At Sea concept. One such program is with David Taylor Research Center, looking at surface combat platforms of the future. In another closely aligned area, our technology thrusts are oriented toward combat systems, but we are taking technology transfer as our primary emphasis. Our on-going projects

include fiber optics, Navy standard computers, shipboard local area networks, and software productivity tools, where, incidentally, we have made significant advances. Yes, we will perform some basic research, but we think our niche is in taking emerging technologies and transferring those into real products for the fleet.

Virtually all large systems in this age are heavily software intensive. More and more of our resources, whether they are people, facilities, or money, support those software aspects. Because of that, we have an initiative we call the *Software Engineering Environment*, to find ways of greatly improving our software development and support capability. We are focusing this effort in a division that has fleet product experience so that we can gain that "having-done-it" familiarity with the work, and, at the same time, it is being set up so that we can draw on researchers within this and other departments.

N Department and other technical departments at NSWC have a major responsibility for the force-level engineering facility at Wallops Island. To date, we have one major facility built and operating there—the AEGIS Combat Systems Center (ACSC), a ship superstructure and building combination, which we refer to as the "AEGIS cruiser on the beach." We are hard at work to make sure a second facility, the Warfare Systems Integration Laboratory (WSIL), becomes a reality. WSIL, or "Whistle," as we call it, would be our command platform on the

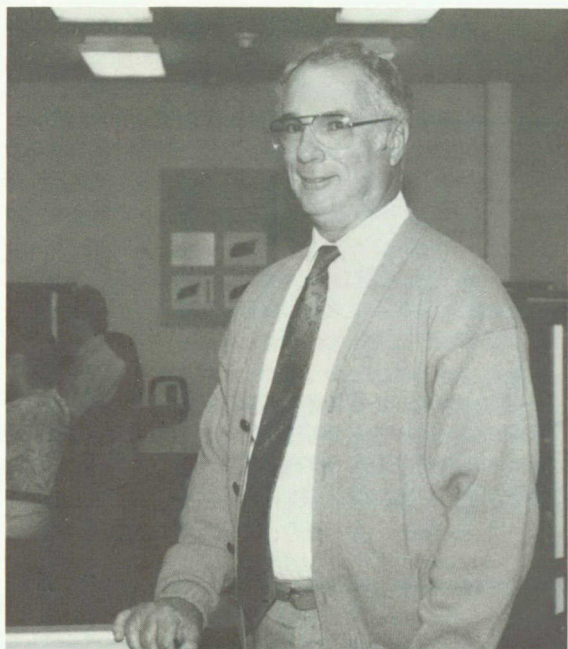
beach. We hope to have another facility, which right now we are calling CSEF (representing non-AEGIS combatants), installed by the mid-1990s. With CSEF, we will have virtually all of the major elements of the battle group for the year 2000. We will then be able to run force-level tests there, even calling on the air elements at Patuxent River and the Surface Navy from Norfolk. I consider Wallops Island to be a very important asset to the entire Navy, not just NSWC.

In the area of rapid prototyping, we began development last year of a system called the Rapid Air Defense System (RAIDS). A project Captain Anderson initiated, it is our first major effort to integrate hard-kill and soft-kill in one system. The Weapons Systems Department is providing the hard-kill component expertise; the Electronics Systems Department soft-kill expertise; and N is to take all aspects and systems engineer them into the prototype system. RAIDS, as a first attempt at hard-kill/soft-kill integration, will establish an important early baseline for this type of self-defense system.

Taking into account all the above—from AEGIS and TOMAHAWK to large-scale facilities—I feel strongly that we have an unusually good mix of work to really make a difference in the engineering of Navy systems. I know we have good people. I believe we *will* make a significant contribution.

Research and Technology Department Accomplishments

by Donald E. Phillips*



Donald E. Phillips, Block Principal for Explosive and Undersea Warheads, Research & Technology Department (R10A).

In 1987, some of the Research and Technology (R) Department's biggest accomplishments were in the areas of insensitive munitions. Munitions safety has been one of the key problems for the Navy in recent years, as the accidental detonation of bombs or warheads can lead to major loss of ships and lives. Making munitions insensitive means building in protection so that they will only detonate when they are supposed to; extreme environmental conditions such as a field fire, a hot magazine, an accident, or the explosion of a nearby munition will not affect them. R Department scientists are developing explosive formulations for munitions that are able to withstand these high temperatures and be less sensitive to shock.

In particular, the Synthesis and Formulations Branch (R11) has developed a rapid, cost-effective scale-up procedure for producing large amounts of a new insensitive explosive compound—NTO (3-nitro-1, 2, 4-triazol-5-one) for

use on all Navy platforms. Department scientists have been working on NTO preparations and associated formulations for three or four years. One example of their progress is developing a process that transforms the irregularly shaped crude NTO crystals into spheroidal crystals, which will reduce the manufacturing cost and increase the performance and safety characteristics of the explosive. We are now conducting laboratory tests to ensure that the compound's properties are unchanged by this process. At the same time, we are developing explosives using NTO with elastomeric binder systems, which also show promise of improving the insensitivity of munitions. The development of NTO impacts the fill for general-purpose bombs, which are carried in large numbers aboard aircraft carriers and other ships. Formulations based on NTO could save the Navy the hundreds of millions of dollars it would cost to repair a damaged ship platform if a munition were to accidentally explode and begin a chain reaction.

The department's most important on-going projects for the Navy are in the area of anti-submarine warfare (ASW). The Soviets have moved from a coastal Navy to a global Navy, with major improvements in their submarines. Working with new explosives and advanced warhead concepts, we have pioneered new technologies capable of producing more lethal levels of damage to these targets. For instance, we developed what we call a *follow-through warhead*, a munitions package that is small, yet inflicts high levels of damage. We are also studying the effect of bubble damage on submarines. When you detonate explosives underwater some of the energy is released in the form of a shockwave; the remaining energy is contained in the bubble of explosion product gases that oscillates and migrates as the gases expand and contract. Interaction of this bubble with a surface ship is known to produce considerable damage; we are studying this to see if the same is true for submarines. We are also looking at advanced explosives for use in mines and torpedoes, which potentially offer major increases in energy. I think we are

making a big impact on the fleet, and this and other work have given the Center a great deal of visibility, both at the headquarters commands and with the operating Navy.

In 1987, R Department passed two major milestones in developing Charged-Particle Beam (CPB) weapon technology. A CPB is a stream of highly relativistic electrons emitted from an accelerator. Last year, we demonstrated that small-angle bending was feasible; large-angle prelude to developing CPB technology into an beam deflections will be tested next year. As a advanced weapon system, it is necessary to develop a method for rapidly redirecting from target to target during a saturated attack. Large-

scale bending of the CPB is accomplished by an achromatic design built with permanent magnets. A magnetic achromat bends electrons with an energy spread through the same angle, thereby limiting the beam dispersion associated with a simple dipole. The ability to make small-angle corrections is important for making aiming corrections and allows a certain amount of target tracking. In 1987, for the first time, we successfully bent the beam at its base. The beam steering project is still in the R&D stage.

Our second major accomplishment in the CPB area was the successful measurement of the beam's radiation shower cone. As a CPB propagates through the atmosphere, the

NTO CONTINUOUS SCALE-UP PROCEDURE

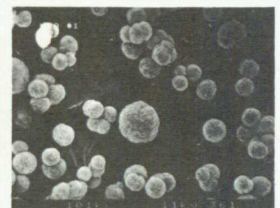


NTO CRYSTAL MORPHOLOGY

CRUDE NTO CRYSTALS

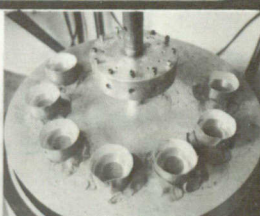
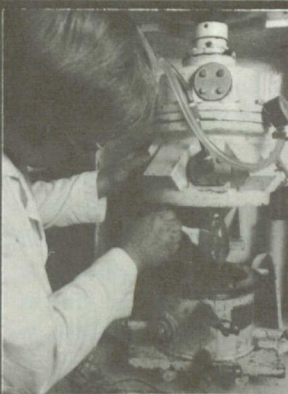


PROCESSED SPHEROIDAL NTO



NTO

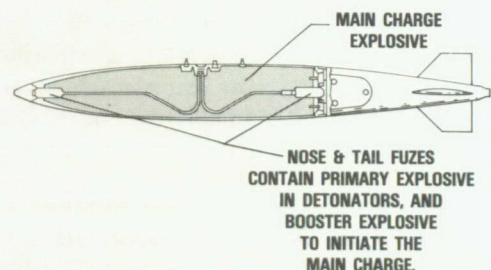
NTO PROCESSING



TOP: VACUUM CAST NTO
LEFT: FINISHED NTO
COMPOSITION

POTENTIAL NTO PRODUCT LINE

MK 80 SERIES LOW-DRAG BOMB



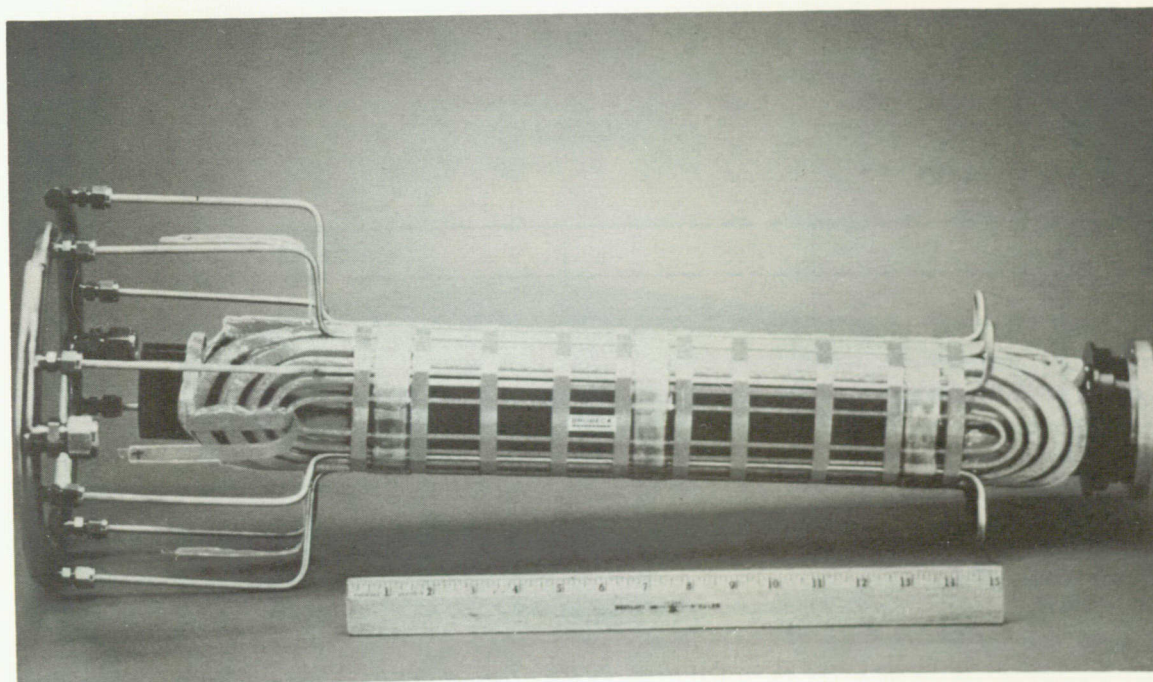
Insensitive munitions developed at NSWC.

individual electrons are scattered by the gas molecules. This scattering process creates intense secondary radiation in the form of rays, gamma rays, neutrons, electrons, and positrons. This radiation forms a cone around the beam which can actually extend the range of the beam. While there is little doubt that an electron beam striking the target will cause much material damage, the radiation cone also has the potential of producing lethal effects both to electronics and firing circuits. This past year NSWC scientists mapped the radiation levels surrounding the beam and have developed models describing the radiation distribution. This information can be used to estimate the lethality range of the radiation cone for future CPB weapon systems. The department also has a successful ongoing program to study beam/target interactions.

In the Materials Division (R30), we directed the development of a metal-matrix composite (MMC) material substitute for four beryllium instrument covers in the TRIDENT II guidance

system, which reduces the cost of these parts by more than 50 percent. Successful flight testing of the new system has been accomplished. We have studied the new generations of MMCs, which are made by incorporating a high-performance reinforcing phase into a conventional alloy, for about fifteen years. These flight tests, begun in March 1987, were the first with production components made from a metal-matrix composite. The results: the TRIDENT II's guidance system functioned normally and, with exceptional accuracy, hit the target. This was our first real breakthrough in production and flight testing. The material will go into the fleet next year.

Advances in superconductivity may allow us to develop new lethality methods. We have been doing some exploratory work in that field here. By drastically reducing power requirements, more sensitive target detecting sensors can be built. Warheads themselves can perhaps be improved, applying the principle of superconductivity to move metal particles or



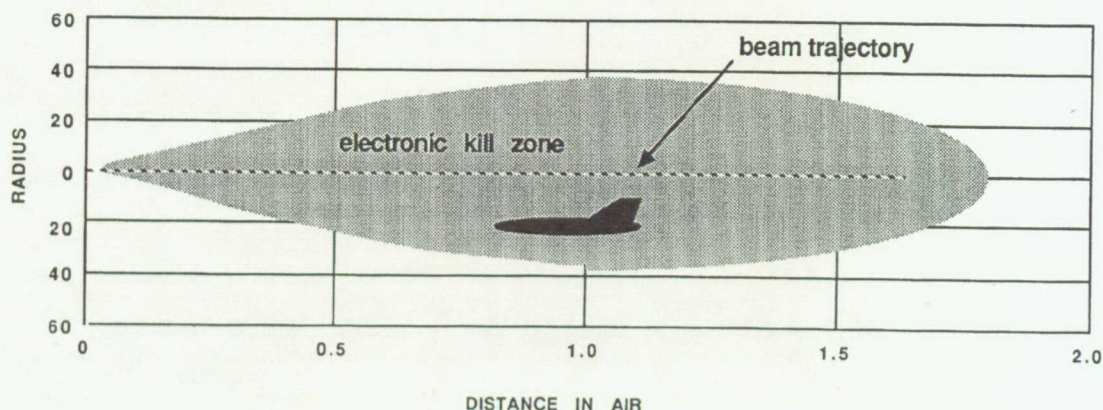
The electromagnetic vernier tested at Lawrence Livermore National Laboratory's Advanced Test Accelerator (ATA). This device, composed of two sets of perpendicularly wound magnetic coils, can produce beam deflections of up to + 2 degrees in two orthogonal planes. In a future CPB fire-control design, the vernier will be used to provide small-angle aiming adjustments.

even entire warheads through the water to the target. This field is very new—the basic research we are working on will soon lead to the application of new concepts to weapons systems.

Our biggest challenge in 1987 was trying to accomplish major progress in a variety of research areas in an atmosphere of generally decreasing funding and personnel. We have entered into an era where the support provided to our work is limited because of budget constraints downtown. This means we must be very selective about what we do and how we do it. The ceiling on personnel also made it very difficult to accomplish many of these tasks. Fewer new personnel are being developed to replace those who resign or retire, and this creates a kind of inertia in the system, slowly eroding the skill base. The Center has provided us the tools to operate more efficiently, such as the new Warhead Analysis Computer Facility, and these help offset the other problem areas.

In 1987, our major achievements in several different areas cover a much wider spectrum of technology than in the previous years. In general, we measure our success by what hardware or concepts are actually transitioned to the fleet or into advanced engineering development. However, even after technology or ideas have been transitioned to the fleet a deficiency may arise, the Soviets may counter our effort, or the performance requirements may change over the lifetime of the system. There is thus a continual dialogue between R Department, other departments at NSWC, and with the fleet. By being technically aware of our fields of specialization and of what is needed in the Navy, we remain responsive, providing solutions when the fleet calls on us.

The global expansion of the Soviet submarine fleet makes our work on the conventional explosives and advanced warheads I mentioned earlier much more important. In this context,



As an intense charged-particle beam (CPB) propagates through the atmosphere between nozzle and target, it loses much of its energy in the form of ionizing and nonionizing (EMP) radiation. This radiation is expected to affect the military utility of CPBs. During the past year, NSWC scientists made the first measurements of the ionizing radiation environment produced near the beam.

these accomplishments have a major impact on the Navy from an operational point of view. We are showing why the Center is here: to solve real Navy problems. My experience in dealing with high levels of the Navy and the Department of Defense is that they look on NSWC as one of the best labs in terms of developing technology and delivering it to the fleet, and we have a reputation of being technically very competent.

**Dr. B.H. Hui and Dr. J.V. Foltz also contributed to this article.*

Research and Technology Department Assessment

by James F. Proctor



James F. Proctor, Head, Research & Technology Department (R).

Like last year I am not going to discuss the Department's accomplishments that Don Phillips has already adequately covered in the previous article. Instead I wish to express my thoughts concerning events, investments and initiatives that will define the future for the Research and Technology Department (R).

First, let me talk about the recent Strategic and Tactical Planning Process that we have completed at the Center. For the past five years or so, R Department has been working very hard to become directly involved with many of the development programs in other departments at the Center as a means of transitioning our technology more rapidly to fleet products. We have done this successfully in a quiet and unthreatening manner and today, over 40 percent of our direct effort is in technology support for other departments. For the first time in the Strategic Planning Process this fact was recognized and acknowledged by the Center, and R has been allowed to remain at

its current strength during this era of limited resources.

Also out of Strategic Planning came the charge to R Department to provide for the future technologies at the Center that will impact our surface warfare mission. This was in response to our proposal to proceed on the following nine technology initiatives:

- Insensitive Munitions
- Biotechnology
- Advanced Ceramics
- Corrosion
- Superconductivity
- Directed Energy
- Superlattice
- Ion Implantation
- Soft Sciences

These are intertwined with the facility and equipment investments that we embarked on last year and reported on in the 1986 History. These investments, for the most part, were multiyear efforts, and I think it is appropriate to report on their progress here.

The \$6M Explosive Research Test Facility, supported by MILCON and ACP funds, is essentially complete and full capability should be on line by mid-1988. The Long Pulse Acceleratory (\$1M), in support of our Charged-Particle Beam and Directed Energy thrusts, has a delivery date of September 1988, with installation and acceptance test scheduled for January 1989. The \$1.4M Background Measurement and Analysis Program (BMAP) Sensor, in support of the Center's IRST system developments, is currently undergoing acceptance testing and will be delivered by June 1988. The Positive Ion Accelerator (\$0.9M) has been completed and is awaiting modifications to Building 405 before installation in December 1988. The Center recently approved the final phase of the \$1.8M Molecular Beam Epitaxy (MBE) System that will support new materials developments. The total system will be completed in February 1989, with installation to

follow in modified lab space by March 1989. The \$0.8M Biotechnology Laboratory to support new materials applications is nearing completion, and we anticipate an operation date of June 1988. Last, the High-Powered Laser Technology Facility (\$0.8M), which will also support new materials development, is expected to be delivered in August 1988, with installation and operation in newly modified lab spaces in Building 152 at Dahlgren expected by November 1988.

Much time has been spent in developing and preparing our vehicles for the technology race. We feel the final preparation and fine tuning stage rapidly approaching in 1988, so that we will be fully prepared to respond to the command "start your engines" by late '88 and enter the '89 technology sweepstakes with a mighty roar.

But, we haven't spent all of our time in the garage or the pits working the acquisition process for these new facilities and equipment. The major accomplishments described by Don Phillips in insensitive munitions, charged-particle beam technology, ASW, and metal-matrix composites are examples of ongoing progress. Although not as spectacular as these, a number of developments have occurred that relate to our initiatives which will make it possible for us to hit the starting gate at full speed. For example, we are continuing efforts to develop multicolor infrared sensors using IV-VI semiconductor alloy films. We successfully fabricated three-color chips and we're beginning work on a two-color linear array. Marketing these developments to interest military and industry has centered around demonstrating the usefulness of these chips to specific military problems via our multicolor infrared camera system. Our expertise in IV-VI materials, epitaxial films, and infrared sensors will serve as a stepping stone in our IV-VI superlattice and multicolor infrared sensors on silicon efforts that will be made possible with our new MBE facility. Hopefully, this new facility will provide numerous opportunities to develop new superlattice electro-optic devices and multicolor sensors integrated to silicon chip technology.

In a somewhat related effort that has been continuing, we submitted a patent application in 1986 for a new ferroelectric random access memory (FRAM) that was believed to be far superior to anything the military had or was developing, but there was concern for its radiation hardness. By design or good fortune, an industrial company was on a near parallel path in developing a suitable ferroelectric material. As a cooperative effort in 1987, the company provided samples of its ferroelectric capacitors to NSWC for the purpose of radiation testing. Our tests showed that these capacitors were very hard to radiation exposure. Therefore, FRAM is superior to all other nonvolatile memories in all respects, such as power consumption, density, weight, volume, output signal, etc. It is expected that the ferroelectric memory will become the future military memory of choice.

Our researchers have continued small but highly effective efforts in high critical temperature (T_c) superconductors while we await the MBE facility and an advanced ceramics facility that will be proposed for FY89-90 ACP investment. For example, we have successfully synthesized the Y-Ba-Cu-O "1,2,3" material and densified it using liquid phase sintering techniques. This yielded a material with superior critical current characteristics. In another area we have had success in capitalizing on past experience of producing flexible ribbons of low T_c materials via rapid solidification and heat treatment processes. A cooperative university/Center effort has produced ribbons using the new brittle, high T_c materials. We hope to develop a satisfactory process to make high T_c wire for Navy applications.

Another breakthrough occurred in 1987 when one of our researchers successfully determined the exact locations and geometrical arrangements of the atoms in two similar samples of superconducting materials. Sample materials were provided by the University of Alabama and Temple University, and the tests were conducted on a crash basis using the intense X-ray beam from the Stanford Linear Accelerator Center's synchrotron. It was also shown that the

atomic positions did not change in going from room temperature to liquid nitrogen—there was no phase change. This represented the first-of-its-kind data on these new materials. Another R researcher has proposed a new theory to help explain the physics of the new high T_c materials. It is being reviewed and evaluated by the research community.

Last, an accomplishment that does not bear directly on any of our new initiatives, but its uniqueness and significance call for comment. A joint R and U Department effort successfully deployed two satellite-linked electromagnetic sensor buoys in the Arctic as part of an ONT-sponsored expedition during March and April 1987. The Arctic Research Buoy is an electromagnetic ambient noise measurement and processing buoy that continuously measures the geomagnetic noise, processes it, and stores it for

data transmission via satellite to White Oak. One buoy is situated on a thick multiyear ice floe, and the second is located about 100 nautical miles away near a shoreline. This project continues to be an outstanding success.

As an old mechanical engineer who has existed in the research environment for over 30 years, I remain in awe of the scientific talent that resides in R Department. Here are some of the top researchers in the world today. I am reminded of this with every issue of *On the Surface* when I read the list of Center papers, reports, and patents that R personnel dominate, and the breadth of subjects. There is no doubt in my mind that the Center has placed its charge to provide for future technologies in very good hands with the scientific personnel in R Department. We *will* have a major impact on future naval surface warfare.

Underwater Systems Department Accomplishments

by CDR L. R. Elliott, USN



CDR L. R. Elliott, USN, Assistant Head for Underwater Systems, Underwater Systems Department (U01).

Last year the Underwater Systems Department (U) made significant progress in developing advanced lightweight warhead technology that promises to counter the current and emergent submarine threat. In particular, the Mk 50 torpedo warhead met all our operational performance test requirements. The results overcame some doubts by members of Congress, and people on the Hill, about the lethality and operability of this warhead. In addition, we demonstrated some improvements that will provide an edge against the threat changes. The completion of a warhead analysis facility last year helped make these accomplishments possible. With the facility, our designers analyzed candidate warhead designs to evolve an optimum model, within the size and weight restraints of the torpedo body itself.

We received an urgent CNO directive to get technology into the fleet as soon as possible that can counteract torpedoes fired at our ships. Our scientists and engineers, within a six-month period, designed, developed, fabricated, tested,

and deployed an acoustic fusing system for an antitorpedo torpedo. From anybody's perspective, to accomplish R&D from the blueprint to the test stage in such a short time is phenomenal. Before this, the only method to counter torpedoes was by maneuvering the ship. We do have a couple of noisemakers that can be towed at the stern, but their effectiveness against Soviet torpedoes is somewhat questionable. I was skeptical when we first began this project—it's hard enough to hit a ship with a torpedo, never mind shooting at something seven feet long in a whole body of water—but now I believe it will work.

In 1987, our NSWC-designed Operational Readiness Assessment and Training System (ORATS) was named an official NAVSEA-sponsored training system for our surface ships. ORATS provides our Navy with the opportunity to conduct training on realistic operational problems, using the installed equipment onboard ship. The fleet units that already have the ORATS system consider it the only effective means of onboard training with their own equipment. Previously, to get individual and team training, the crew had to go to an ASW training center on shore. The actual signals and targets used there were not too realistic. The trainee also did not have much control over the equipment setting; with ORATS, the trainee can program his or her own signals. Now vital training can be accomplished anytime, without personnel being tied down to a shore station. This is particularly important because we have quite a few ships deployed in the Persian Gulf and in the Mediterranean.

We also adapted our Passive Acoustic Display Simulator (PADS), developed for classroom acoustic analysis training, for use as a battle group trainer. This provides each ship with a simultaneous passive sonar display that shows direct contacts as they would appear on their own passive sonar. The displayed contacts from all the ships are forwarded to the combat information center and, from there, up to the battle group ASW Commander. With target and ship maneuvers controlled from a central

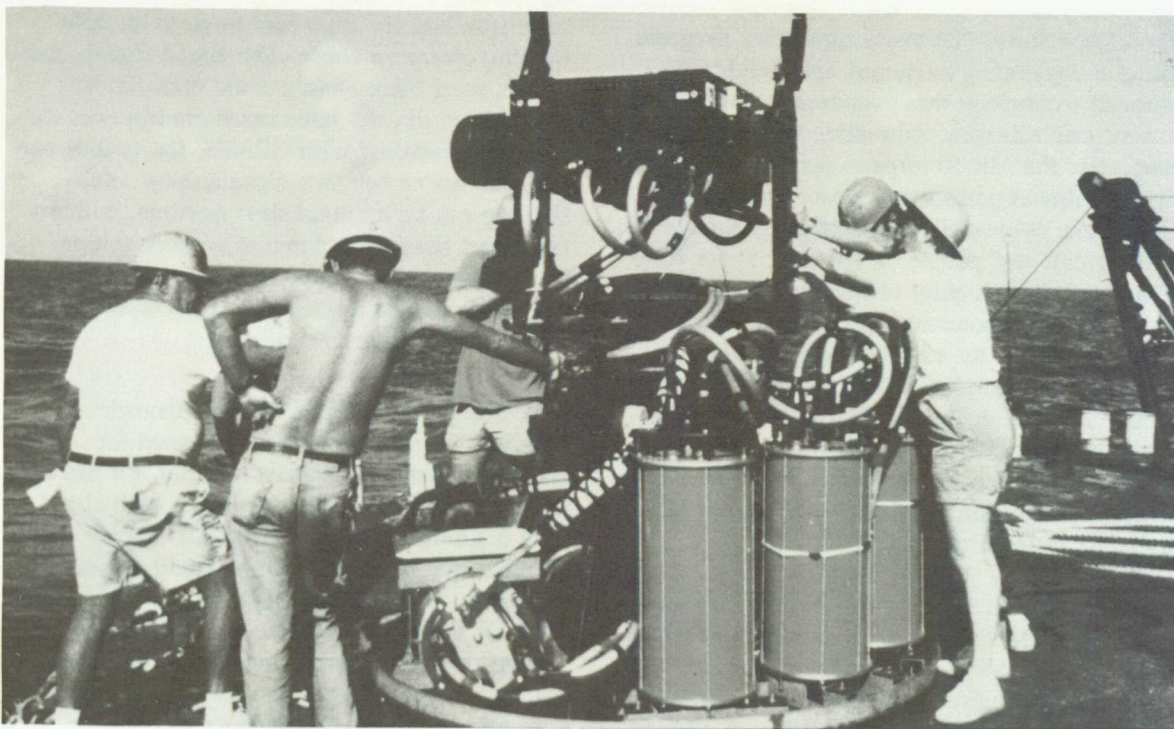
console, whole battle groups can practice coordinated ASW operations. Previously, they used dummy inputs to simulate targets, but that did not provide instruction for the acoustic operators.

We installed two Automated Quick-Look (AQL) devices at two of our naval air stations for use by P3 squadrons late last year. The AQL is a tactical intelligence analysis system. Designed at NSWC using commercially available hardware, we also wrote all the system software. The result: a more efficient, effective use of fleet assets and a greatly reduced turn-around time on the tapes gathered from sonobuoys. Better resolution and faster data processing mean that if the signals reveal something of interest we can send another mission out to search much sooner. Our planes will then have less territory to cover because the submarine would have had less time to travel. As the threat becomes more silent, we need to continue improving resolution in order to detect enemy vessels. What drives most of our R&D in the ASW field is the knowledge that the Soviet

threat is becoming quieter and quickly approaching the same level of detectability as our own ships.

The research we did for SEAL (Sea, Air, and Land) forces weapons really impacted the fleet. Last year, we tested and deployed the SEAL equipment canister. The SEAL team goes out through the egress chamber, while their equipment, weapons, and explosives are placed in the canister and fired from the torpedo tube. The team then meets up with the canister and retrieves their equipment. In the past, they took their equipment out through the egress area. Then, we could only fit two SEALs with equipment in the egress area; now, we can fit four or five SEALs, while launching their equipment in the canister. This speeds up team deployment by a factor of two.

Much of our contribution in this area results from quick response to SEAL needs. One example dealt with the Mk 48 timer for explosives. Last year, during a SEAL exercise, they had a premature explosion using this



NSWC personnel prepare to "plant" underwater tracking array as part of mine testing activities at Ft. Lauderdale.

device. One of their primary pieces of equipment, the Mk 48, had to be placed in a restricted status because of this incident. They brought the device to us and we tested it in our Undersea Weapons Tank. While investigating, we discovered that only one lot was faulty; subsequent lots were okay. As a result, the good lots were put back into full service and the bad lot corrected. The SEAL team had this valuable piece of equipment back in action within a very short period of time.

Another area we made significant advances in, one becoming increasingly important because of the Persian Gulf incidents, is the mine neutralization system to place explosives on mines to destroy them. A long-term project, the pre-production unit for this, called the Mk 57 Limpet, was successfully tested last year, and is now being produced to go aboard new mine countermeasure ships. The Navy selected the Underwater Systems Department to develop this system because of its outstanding reputation in

warhead design, safety and arming systems, hydromechanics, and test and evaluation. Systems of this type improve the fleet's ability to counter the mining operations against the United States and its allies.

The work U Department did in 1987 had a big impact on the active fleet. We came a long way toward giving the Navy a lethal torpedo that will keep up with the emerging threat. We greatly improved the capability of our forces to train for tracking and localizing this threat in order to get that torpedo on target. At the same time, we found a way to use our torpedo in a hard-kill defensive capacity, which is especially important in protecting our aircraft carriers. In 1987, we developed these, and other items, tested them for operability, and put them into production for fleet use. Four or five accomplishments like this constitute a very successful year for us. In the meantime, our operational forces, with improved capabilities, stand more prepared to defend U.S. interests at sea.

Underwater Systems Department Assessment

by Betty H. Gay



Betty H. Gay, Head, Underwater Systems Department (U).

Since Antisubmarine Warfare (ASW) has been specified as the Navy's top-priority program, it has received considerable attention by our management team. Obviously, it would since our mission is underwater systems. We have had several outstanding achievements in 1987 in the ASW area. Our success in the development of the Mk 50 Torpedo Warhead has been outstanding and has been recognized at the highest levels of the Navy. The Mk 50 will provide the fleet with a highly effective, lightweight torpedo to counter the current and emerging submarine threat. I attribute the success of this program to competent people, who are very dedicated, and to our excellent facilities, not only in the Underwater Systems Department (U), but throughout the Center.

In 1987 we worked closely with the Research and Technology Department (R) in transitioning warhead technology, and we used resources in the Protection Systems (H), Research and

Technology (R), and Weapons Systems (G) Departments to perform test and evaluation.

Culminating more than two years of planning, the Warhead Analysis Facility is now a reality. A joint endeavor of the Research & Technology Department and the Underwater Systems Department, the facility came on line in September and was dedicated in December. This facility will contribute to our ability to design and analyze underwater warheads and will contribute in the future design of warheads not only for torpedoes but also for underwater mines, SEAL weapons, and mine neutralization systems. The facility gives us excellent capabilities, with a lot of room for expansion.

Also noteworthy in the ASW area is NSWC's designation in 1987 as Life Cycle Support Agent for the Mk 116 Mod 7 ASW Control System (ASWCS). This was a major Center thrust in 1987 and has established NSWC as a major participant in Surface Ship ASW. It was essential to our becoming established as a major player in Surface Ship ASW, and we feel that being the laboratory for surface warfare, this was a role we absolutely needed to have.

A major aspect of this effort is our involvement in the SQQ-89 Improvement Program as the Systems Engineer and the Systems Integration Agent (SIA). The SQQ-89 is the Surface Ship ASW System, and the Mk 116 Mod 7 is the control system part of it, but the SQQ-89 includes the sonars and displays associated with it. As an analogy, this ASW system is to underwater what the AEGIS AAW system is in antiair warfare. It includes sensors, command and control, and displays for the underwater warfare portion of the surface ship. This system is having a major impact on the Navy in that it significantly enhances the ability of surface ships to detect, classify, and localize submarine targets at long ranges.

We opened a new facility called the Advanced Computer Systems Architecture and Development Facility, whose purpose is to look at various architectures of control systems or

communications systems; man-machine interfaces; advances in artificial intelligence; and new neural networks. The end product is to improve getting the information from under the ocean to the operator in a way that he can more easily use it. This state-of-the-art facility is extremely valuable. It has speeded up our ability to analyze large-scale software systems. Its modern design tools speed up our ability to actually write programs or convert software programs. The products from this facility are being used on the ASW WSA&E and the SQQ-89I programs.

Another feather in our technological cap in 1987 was our work on the fuzing system for the Surface Ship Torpedo Defense System. Our people designed, built, and tested the system within six to nine months. Those test results showed that it worked very, very successfully. The Surface Ship Torpedo Defense Program is one of the highest priority items in OP-03 and our involvement in it was significant in 1987.

Unfortunately, we tend to forget mine warfare as a vital part of ASW. We recorded several significant achievements in this area. The Advanced Sea Mine is being developed jointly by the United States and the United Kingdom; NSWC is providing the technical direction, particularly in conducting experiments and tests to reduce the technical risk in this program. Our work helps PMS-407 define the system requirements used in the specifications.

We completed studies leading to improvements to the CAPTOR Mine, and drew up a Development Options Paper (DOP), and recently received funding to implement the Plan Of Action and Milestones (POAM) developed for CAPTOR.

Meanwhile we have continued to improve the Target Detecting Device in our bottom mines and have developed the capability for delivering mines with low-altitude aircraft flying at very high speeds.

Another important product line where we have had some significant achievements is the

development of underwater ordnance for the special forces.

Finally, the current events in the Persian Gulf have placed increased emphasis on the Navy's mine countermeasures. While this is a major leadership area of the Naval Coastal Systems Center in Panama City, Florida, NSWC is actively involved in designing the warhead systems. One such system is the Mine Neutralization Device, a device that locates a mine and destroys it. It's not a device that pulls the mines out of the water. Instead, a piece of explosive is placed beside the mine and destroys it by exploding it.

We recently completed TECHEVAL and OPEVAL for the Mk 57 Limpet Mine Neutralization System, which is scheduled to go aboard the Navy's new mine countermeasure ship, *Avenger*. We expect it to significantly increase the Navy's ability to protect U. S. ports and sea lanes as well as counter minefields in third-world countries.

We had an excellent track record in 1987 and expect to have just as good a track record in 1988.

Our strengths have been in the tremendous competence of our people, both technical and managerial, cooperation among departments, and good facilities to complement the people. We have been fortunate in that ASW is a high-priority Center effort as well as high-priority Navy effort. Hence, we have continued to get top management support at the Center in hiring good people, in getting MILCON for new facilities, and in getting ACP funds to improve existing facilities. Strategic planning, complemented by tactical planning, has forced all levels of management to think about the future and plan resources to meet the future needs. I believe the Strategic Planning in ASW that started back in the early 1980s is now beginning to bear the fruits for our efforts.

Overall, the mission of the department did not change appreciably last year, but it did expand in the Navy thrust areas. For example, as I

mentioned, we did solicit and achieve a significant role in the Mk 116 ASW control system (ASWCS). This means our department will take on a more extensive role in software development vice its traditional role in mine and torpedo hardware development. We intend to maintain a strategic balance between software and hardware development.

We have also expanded our workload to include the fuzing system for Surface Ship Torpedo Defense (SSTD). This is a thrust area for the Navy and is vital to the survivability of surface ships in the ASW threat scenarios.

As for the future, I foresee that the ASW problem will be with us for many more years. In the area of underwater weapons, this means

we will continue to develop new and improved warheads for torpedoes, new mines, new mine neutralization systems and SEAL weapons. Surface Ship ASW Warfare Systems will continue to be a thrust area with our involvement in the Mk 116 Mod 7 Fire Control as the stepping stone.

Protection of our surface ships from torpedoes will continue to be a thrust area with emphasis on more sophisticated measures to counter more sophisticated enemy torpedoes. As the ability to target submarines at longer ranges improves, the integration of longer-range ASW standoff weapons on surface ships will become an important thrust area. We are indeed moving to better support Surface Ship ASW Warfare.

The State of the Technology Base

The State of the Technology Base

by Bernard F. DeSavage



Bernard F. DeSavage, Head, Technology Base Program Office (D4)

Nineteen hundred and eighty-seven was a bittersweet year for Technology Base Programs. Funding Levels were again reduced but in spite of that adversity, NSWC scientists and engineers again displayed their can-do spirit and productivity was high in both quality and quantity. We discover time after time that the core of our Tech Base is our people. Never in my experience has that fact been made better known than during the selection process for the 1987 NSWC Science and Technology Excellence Award. Each technical department nominated its best, and the Center Tech Base Council, which served as a peer selection group, had a most difficult time in singling out the best of the best. It's the people like **Dr. Ernst Schwiderski**, the 1987 winner, and the host of unrecognized winners "at the bench" who have produced the work represented by the accomplishments that follow. Technology is alive and well at the Naval Surface Warfare Center.

The Independent Research Program is a critical segment of the Center's Tech Base Program. It is the Technical Director's discretionary funding source to initiate new thrusts for the Center at the basic research level. In the past the IR Program has pioneered new and safer naval explosives, developed magnetostrictive materials whose performance far exceeds that of earlier materials, and advanced the understanding of the physics associated with charged-particle beams, to mention a few. The following is a small sampling of that Program.

High-Temperature Superconductivity

The world is perhaps at the brink of a technology revolution akin to when the transistor was invented. A class of materials was discovered in 1987 by IBM scientists that exhibited superconductivity at a temperature above the boiling point of liquid nitrogen. The importance of that discovery was recognized by awarding the discoverers that year's Nobel Prize. A key to the practical application is a fundamental understanding of underlying physics and chemistry that gives rise to superconductivity in these ceramic materials and the means to produce them in engineeringly useful form. NSWC scientists have discovered the ubiquitous presence of twin boundaries in the orthorhombic phase of these materials and postulated that these boundaries are responsible for the higher superconducting transition temperatures, the higher critical magnetic field and currents. Analogous correlation has been reported for the classic low-temperature superconductors. A general theory of this effect based on electronic states localized at the boundaries was initiated in 1987 under the Independent Research Program.

Nonlinear Dynamics and Fractals.

Mathematicians and scientists have come to recognize that much of what goes on in nature is not as random and noisy as once thought, but contains subtly intricate behavior appearing to

be chaotic at first glance. This new world has been popularized in the best-selling book by James Gleick called *Chaos: Making of a New Science*. Therein is retold of early work at MIT in modeling the earth's atmosphere and the surprising onset of dramatic changes resulting from seemingly insignificant changes in boundary conditions. Hence the so-called Butterfly Effect—a butterfly's wing flapping in China ultimately resulting in a storm in North America. An exaggeration? Perhaps not. NSWC physicists and mathematicians have been studying and advancing the science of nonlinear dynamics and fractals as they might apply to Navy problems. Results to date are impressive: 1987 saw the first experimental verification of fractal hypothesis on the description of infrared cloud radiance, perhaps eventually leading to improved clutter rejection forIRST systems by better ability to mathematically describe a cloud. High-power sonar transducers are clearly of interest to the Navy, and NSWC has been a leader in the development of magnetostrictive materials (that capability developed under the IR Program much earlier) with application in bifurcation transducers. A better understanding of the bifurcation process in amorphous magnetostrictive materials and relation to chaos was accomplished with the observation of sub-harmonic noise-bump precursors to period doubling during magnetic driving. A program was initiated, with the help of ONR, to establish an NSWC Navy Institute for nonlinear dynamics, aimed at establishing strong university ties and, through an active postdoctoral program, a heightened atmosphere for research within the Center.

Impact Dynamics

Accurate prediction of damage sustained by a target is a valuable tool in the design of weapons systems. A fundamental part of a damage prediction model is an understanding of the effects and mechanism of impact on materials.

The Impact Dynamics project brings together NSWC research efforts related to the behavior of

materials under high-velocity impact, shockwave, and other forms of high-strain-rate loading. Many types of naval weapons involve impact- or explosive-induced stress waves to inflict damage on a target structure. The objective of this project is to understand and describe the physical processes in the dynamic response of materials to shock loading and high-velocity impact, in order to provide a basis for solutions to problems of impact fracture, penetration, warhead design, and survivability. The approach involves a combination of impact experiments, dynamic material properties measurements, theoretical model development, and computational simulations.

Specific subtask areas include experimental studies of fragment and penetrator impact effects, theoretical modelling of shear band formation in metals, and numerical modelling of impacts. Significant results include: (a) experiments with single-crystal and polycrystalline cube fragments of a nickel-base superalloy impacted on cube faces indicate that single-crystal materials in which the atomic planes are aligned with the faces of the cube are more resistant to impact fracture; (b) rod-plate impact experiments have been performed over a range of impact velocities to obtain information about the energies required for nucleation and propagation of shear bands, in support of theoretical modelling efforts; (c) experimental techniques have been developed for controlled impact fracture studies of warhead fragments at high temperatures representative of those induced by explosive shock heating; (d) reverse-ballistic techniques have been developed for studies of synergistic damage effects in multiple-fragment impacts; (e) a quantum mechanical description has been derived for the operation of a dislocation source, leading to predictions that agree well with experiment, including the two-wave elastic-plastic structure and observed rate-of-rise of the plastic wave as a function of the applied shear stress; the width of the shear bands have also been predicted; (f) a higher-order Godanov scheme was developed to compute solutions to a one-dimensional problem of the impulse loading of a deformable block

surrounded by gas in a shock tube; and (g) gas-gun impact experiments and diamond-anvil static high-pressure studies performed with Metglas specimens indicated the absence of a shock-induced polymorphic phase transition.

The Independent Exploratory Development (IED) Program is the Technical Director's discretionary 6.2 source of funding corresponding to the 6.1 IR Program. Like the IR program, IED is a rapid means of bringing new internally conceived ideas to a point of concept demonstration. The variety of funded programs is as broad as the imaginations of the scientists and engineers participating in the program. The 1987 IED Program had nearly 30 tasks in such diverse areas as munitions and weaponry, information sciences and command and control, surveillance, electronic warfare, and directed energy. The following describe a few of the 1987 highlights.

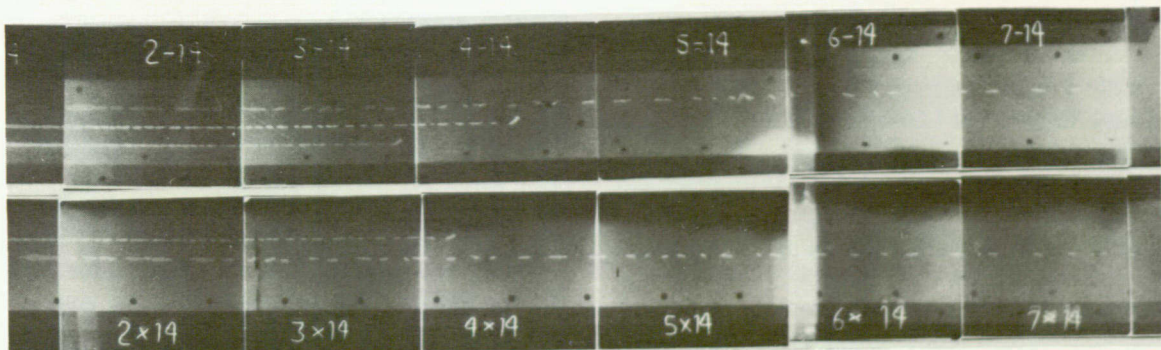
Penetration of Fluids by a Shaped-Charge Jet

The Navy has a need to be able to design and assess the performance of hypervelocity penetrators that have water as part of their target path. Shaped-charge jets for underwater application are an example of this type of warhead. Much study and development has centered around shaped charges, however the other services do not anticipate fluids as an important part of the target and consequently virtually no effort has been expended on this problem. The aim of this project is to model the

physical processes connected with hypervelocity water penetration and thereby produce a predictive model that is sufficiently simple and accurate to be used in design work with shaped-charge jets. This effort supports optimization of underwater warheads for new weapon systems as well as lethality studies for current designs.

The main issue studied was "afterflow," where the cavity interface continues to advance even after the jet particle that created it has been consumed. Afterflow results in an enhanced penetration. The study has been approached by a coordinated use of three different investigations:

- 1) A very simple cavity drag model was developed that has one adjustable constant. The cavity is modeled as a constant shape pseudo body with the virtual mass of the water that is displaced. The motion of this pseudo body determines the afterflow.
- 2) A comparison between the results of PISCES computer hydrocode calculations and the cavity drag model permits a general assessment of the model as well as the evaluation of its water impact through the afterflow regime.
- 3) Experimental data are being used to verify or improve the cavity drag model mentioned above. Comparisons of predictions with test data will evaluate the accuracy of the predictions based on a constant drag coefficient.



X-ray photo of a shaped-charge jet

In the cavity drag evaluation the PISCES hydrocode was run for four different particle velocities. As a fallout of this work cavity shape, shock standoff distance, and the velocity and pressure fields were also found, which could not easily be obtained experimentally. To a large extent, a single value for the cavity drag constant matches the PISCES results.

Two important questions developed as a result of initial work. One concerns any change in the cavity drag coefficient that would follow from the breakup of a particle as it spreads out and thins along the cavity interface. An increase in drag is predicted by PISCES due to particle disintegration. A second question is, to what extent is a particle's effectiveness decreased by having to penetrate the debris of the proceeding particle before it can start to penetrate water? Both of these effects are important because they impact the ability to deal with these problems when the actual motion departs from the idealized model. In addition, a broader range of jet density and particle length is being investigated with PISCES and will be used to refine the cavity drag model.

Prior experimental data with shaped charges were in a range where afterflow is expected to be small so that it is difficult to use this work to accurately test the theory. Furthermore, the various competing nonideal effects make it difficult to separate out afterflow as a separate phenomenon. Therefore in order to be able to compare experimental results and PISCES calculations, a gun experiment is also being planned in which a single particle impacts water.

Visual Programming Approach to Graphics Software Development

The objective of this task is to evaluate the utility of a visual programming approach to graphics software development. A graphics software programming tool (GraphCAD) will be developed that will allow a programmer to interactively create a dynamic graphics CRT display format. The major design goal is to

provide the programmer with a high-level interface that minimizes the requirement for detailed knowledge of the display system hardware and software. Another design goal is a flexible software architecture that will accommodate a wide variety of target graphics devices and that will be extensible to support visual programming of more general classes of programs.

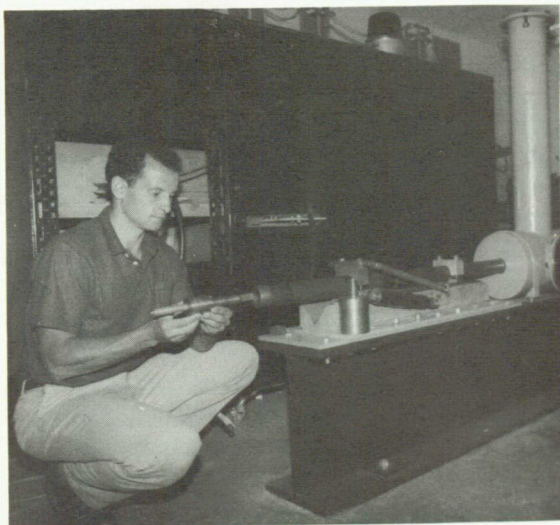
The tool will provide a visually oriented human computer interface similar to current Computer-Aided Design (CAD) systems. The tool will provide an interface between the graphics entities manipulated on the screen during program creation and externally generated functions programmed in Ada. This will allow the external functions, which may represent sonar, radar, etc., to change display format entities dynamically (e.g., change a symbol's position based on track information). GraphCAD will generate an Ada source code representing the body of the overall control program, the graphics generation and database management procedures, and the interfaces to external procedures or tasks. The resulting code will be compiled and linked with the external functions using existing commercial software.

The design of the GraphCAD software will be structured to facilitate extensions to accommodate different graphics interfaces and hardware capabilities (e.g., Metheus, HP 9020 Navy Standard Desk Top Computer, PLOT 10, GKS, etc.), different target programming languages (e.g., Ada, CMS-2, FORTRAN, etc.), graphical design icons and control structures tuned to more generic visual programming, and interfaces to other software analysis and development tools. FY88 efforts will include the design and implementation of a GraphCAD system with the following characteristics: a graphics application program oriented visual interface, hosted on a VAX computer, programmed in and targeted to Ada source code generation, Metheus 3610 graphics host and target graphics interface, and a PLOT 10 target graphics interface.

The system will be evaluated through the creation of prototype ASW Combat System display formats. The tool will be evaluated for ease of use and efficiency of code generated.

Muzzle Velocity Control with Electrothermal Guns

Because electrothermal (ET) guns offer a significant improvement in muzzle velocity over conventional guns, they are well suited for an AAW role where fast reaction time, and therefore fast muzzle velocities, are critical. In addition, its high muzzle velocity and relatively simple configuration make this gun potentially useful in a lethality testing role. The objective of this project is to evaluate this new technology for Navy applications from a hands-on point of view. A second more specific objective is to demonstrate the control of projectile velocity during launching. This would ensure a consistent muzzle velocity from round to round, simplifying the fire-control solution.



Test bed for the Electrothermal Gun

The ET-gun uses a barrel and a projectile similar to that of a conventional gun. The difference exists in the cartridge of the round.

Whereas in conventional guns the cartridge consists of a coaxial electrode arrangement located behind a container of working fluid (typically water, but it could be a low molecular weight energetic fluid). When the coaxial electrodes are energized by an electrical power supply, a long arc is established between the electrodes, resulting in a jet of high-temperature plasma being injected into the working fluid. This causes the fluid to expand, which leads to the acceleration of the projectile. The high velocities are achieved as a result of the working fluid being a light molecular weight substance, which does not limit the sound speed in the propelling gas (and therefore the projectile velocity) to the same degree as conventional propellants. The velocity time-profile of the projectile in the barrel is controlled by the shape of the electrical power pulse delivered to the plasma-cartridge. Since the shape of this pulse can be varied in real time, during the time of acceleration, the muzzle velocity can be controlled (increased or decreased) through the use of a feedback scheme.

A test bed gun was designed, built, and successfully tested (at a reduced energy level) in FY87. This device uses a conventional 20mm test barrel to which a plasma cartridge has been adapted and is powered by a 20KV, 300KJ, capacitor-driven, pulse-forming network. The present effort includes shooting 15-gram projectiles to approximately 2km/sec, along with demonstrating the ability to change projectile velocity during launching.

The largest segment of the Center's Tech Base Program are the 6.2 Technology Block Programs assigned for management to NSWC by the Office of Naval Technology. Five Blocks were assigned: Surface Launched Weaponry, Mines, Weapons Materials, Chemical/Biological Warfare Defense, and Explosives/Warheads.

NSWC is also a performing agent for Marine Corps Headquarters for their Weaponry Technology Block. The following is a sampling of highlights from what is a large, highly productive Program.

EXPLOSIVES AND WARHEAD BLOCK

Prediction Method for Underwater Explosives

A new prediction method has been devised to allow identification of novel fuel-oxidizer mixtures that have potential utility as ingredients for underwater explosives. The method makes use of recently identified relationships between known or easily measured thermochemical properties and measurable underwater explosive performance parameters such as shockwave energy and relative bubble energy. All available underwater test data were analyzed to find the best correlations between underwater explosive performance and chemical properties such as heat of detonation, quantity of product gases, molecular weight of the gases, and initial density of the explosive. Very useful correlations were found, which appear to be relatively insensitive to reasonable assumptions of decomposition path.

This prediction method will now be used to guide selection of ingredients for incorporation into new underwater explosives. Performance and insensitivity requirements of undersea weaponry warheads have stimulated the search for advantageous explosive materials, and an extremely large set of candidate fuel-oxidizer combinations has been identified. The new prediction tool will allow development attention to concentrate on only the most promising of these materials.

Impact Energy for Ignition of Insensitive Explosives

An impact machine has been developed that measures the amount of plastic work energy deposited in an explosive or propellant sample during the impact event. Previous impact machine designs provide only qualitative go/no-go results in terms of drop height for an impact hammer of specified weight. Such results are of little benefit in the search for a physical understanding of explosive response during impact. Instrumentation of the new machine allows a distinction to be made between the

elastic energy stored within the machine and the plastic work required to deform, heat, and ignite the sample during impact. This provides a true measure of impact sensitivity of an explosive. The measured amount of plastic work to cause ignition is easily converted to energy density for ignition, thereby giving the modeler a way to calculate likelihood of ignition occurring in an explosive or propellant during an arbitrary impact event. Results with the current design closely reproduce data from earlier tests, which involved widely varying machine designs and impact velocities. Data to date suggest that, for a given explosive material, the amount of plastic work to cause ignition does not vary significantly for a two order magnitude change in impact velocity. This implies that energy to ignition data obtained at convenient impact velocities for insensitive explosives can be used in modeling impact ignition at much higher impact velocities and with arbitrary impact configurations.

Analytic Warhead Design

The challenge of a rapidly growing advanced Soviet submarine threat has led to improvements in undersea weapons systems to assure that warhead effectiveness is maintained. This is a two-pronged approach: obtaining a better and more complete understanding of the damage produced by the detonation of an undersea warhead, and using this information to design and validate innovative warhead concepts. In 1987, the Navy continued a strong effort (initiated in 1986) to use sophisticated computer codes to aid in concept design development. This permits evaluation of design alternatives for operation and performance before costly hardware is built and tested. Although specific results of the analysis need to be verified by experiment, computer analysis provides a better understanding of concept operation, which leads to improved designs prior to hardware build and testing. The computer analysis also identifies critical design areas to be examined in testing, which has resulted in substantial increase in the information gained through testing. The

coordinated efforts between computer analysis and testing are proving to be very beneficial, and are expected to lead to more rapid development of optimum warhead designs.

Transition of Improved Undersea Warhead Technology

The Undersea Warhead Block Program transitioned several technology improvements in 1987.

The effects of bubble loading from an underwater explosion on a submarine structure was the subject of a major series of tests in 1986. Evaluation of these test results compared to predictions of the SUBWHIP Computer Program, a state-of-the-art Navy code for predicting the elastic response of a submarine subject to underwater explosion, has proven very successful in providing valuable insights into submarine structural response for a variety of explosive compositions and modes of attack. This technology is now being used in the design of the SSN-21.

The Follow-Through Warhead concept was selected to begin transition into the Balanced Technology Initiative (BTI) Program in 1987. This warhead concept, a joint ONT/DARPA-sponsored program, had addressed and successfully solved several issues relating to concept feasibility by the end of FY87. The remaining ONT/DARPA issues are scheduled for completion in FY88 for transition into the BTI Program.

An acoustic fuzing sensor was transitioned from the 6.2 block program in FY87 for development by the Surface Ship Torpedo Defense (SSTD) Program. This sensor provides a substantial improvement in range and range resolution capabilities over systems that have previously been used.

SURFACE-LAUNCHED WEAPONRY BLOCK PROGRAM

Search and Track Sensor Test Site

During FY87 the Search and Track Division (F40) established a Sensor Test Site on the Potomac River Range. The NSWC Dahlgren Potomac River Range is a 15-nautical-mile, controlled-range instrumented for ground truth and environmental monitoring operation, manned by an experienced technical staff. The range will support the presentation of known targets at low altitude in severe multipath and under a wide variety of weather and atmospheric conditions. Liaison has been established with the Patuxent River Air Training Center, Oceana Naval Air Station and the Marine Base at Quantico to provide subsonic manned aircraft services. Additionally, the range will support the use of projectiles and rockets as targets (both incoming and outgoing).



Site for testing various means of integrating multisensor information.

F40 currently operates three sites along the shoreline of the river range:

- a. C-Gate site (current Mirror Track Radar/Laser Radar site);
- b. Main Range North (Current Weapon Control site in area of building 1370); and
- c. Machine Gun Range Site (in area of current SPS-30 site).

Major capital improvements are planned for the Main Range North site, including the addition of a modular building and fiber-optic links to other sites. The test site currently incorporates operational Navy sensor systems, such as AN/SPS-10, AN/SPS-30, AN/SPS-64, and AN/KAS-1. In addition, unique one-of-a-kind R&D sensors are currently at the site. Examples include the FLEXAR radar, the NSWC/ITT Focal Plane Array IRST, the Laser Fire Director, and a laser radar.

Several programs—CIWS, Search and Track Technology, and NATO AAW—intend to utilize the range in ongoing R&D efforts over the next several years. A significant amount of activity for NATO AAW is already occurring.

High-Speed Missile Experimental Aerodynamics Technology

In FY87, three high-speed wind-tunnel tests were conducted to support the STANDARD Missile Lead Laboratory Program. These tests provide data for the design of missile control and lifting surfaces. In the first test, fin leading edge candidate materials were subjected to specific thermal trajectories similar to those experienced in flight. Surviving candidate materials were evaluated to document the effects of the erosive, high-temperature environment. In the second test, special instrumentation was designed and tested to measure aerodynamic heat-transfer coefficients on small radius leading edges of fins. Test parameters included variations in leading edge radii, sweep angle,

and Mach numbers. The effects of bow shockwave impingement on fin leading edges were simulated. The third test involved measuring fin hinge moments for two missile fin planforms: one, the current STANDARD Missile planform; the other, a highly swept planform designed to reduce aerodynamic heating. The results from these tests supply critical design trade-off data required to optimize high-speed missile control surfaces. The tests also support efforts to validate aerodynamic, aeroheating, and structural design codes that are being developed through the Surface-Launched Weapons Aerodynamics and Structure Technology Program.

Missile Trajectory Optimization

The Center has supported development of state-of-the-art missile trajectory optimization codes over the past four years. These codes allow the rapid determination of optimal midcourse trajectories for missiles. These methods greatly reduce the manpower requirements and place the midcourse guidance trade-off studies on a rigorous basis. A number of in-house programs have made use of the methods, including the STANDARD Missile Lead Laboratory Program. Complete midcourse algorithms have been developed for conceptual and current missile designs. This work has been transferred to other DOD agencies and to Raytheon Missile Systems Division, prime contractor for the SM-2 Block IV design. As the anti-air warfare environment becomes more demanding, greater overall missile system-level performance will be required. These optimization techniques will give designers the tools they need to meet this goal.

MARINE CORPS WEAPONRY BLOCK PROGRAM

Improved Accuracy Program

NSWC has taken a leading role in the development of techniques to reduce the free-flight dispersion of rockets. Typical dispersions

in the range of 8-16 milliradians are common, but analysis has shown the potential to reduce this dispersion to 2 milliradians or less by compensating for the independent contributions of thrust misalignment, tip-off, and cross-winds. The most promising technique to date combines technology in solid-state sensors, thrusters, and microprocessors to cost effectively and reliably handle the response times necessary for the control of existing and future direct fire rockets. Present-day applications for this technology exist in air-launched rockets and tactical systems, such as MLRS. In-house design of such a system has progressed well, and an initial proof-of-principle system will be tested in FY88.

MINE TECHNOLOGY BLOCK PROGRAM

Acoustic Array

An acoustic array assembly to generate data for a data base expansion was successfully deployed on the underwater range at NSWC Ft. Lauderdale. This array, the most complex and sophisticated ever built in support of a mine program, was a joint 6.2/6.3 effort implemented by NSWC under the direction of ONT and PMS-407. The 6.2 phase of the program developed the technologies necessary for the array itself. The array assembly was a 307 element, baffled, planar, multiarray covering much wider bandwidths than have ever been previously considered in underwater mines.

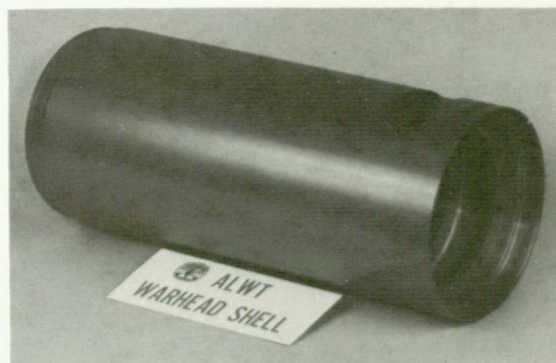
The 6.2 Mine Block program developed the array design and performed the analysis of tank testing of partial array assemblies; 6.2 will also be involved in the data analysis of the in-water array performance. Both the size required of the array to accomplish the DBE task and the much broader bandwidth requirements presented some unique technology questions not normally encountered in the design of conventional mine detection systems that were addressed by 6.2. These were such issues as whether an array of such size could be designed to the noise floor requirements; whether an array with the gains required could be electronically steered to the

extreme angles required; whether there would be degradation due to the array acoustic edge effect on beamforming; how to achieve the required acoustic element to baffle spacing and meet other mechanical/acoustic requirements simultaneously as well as technical issues related to the analysis of the in-water data.

WEAPONS MATERIALS BLOCK

Powder Metallurgy Aluminum Alloys for Ordnance Applications

Several new powder metallurgy-produced aluminum alloys are under development for use as structural materials in advanced Navy torpedo systems. Conventional ingot metallurgy materials are not able to provide the combination of strength and corrosion resistance needed for lightweight and durable shells to meet the needs imposed on these weapons by emerging deep-diving threats. Work supported by NSWC has demonstrated that these materials can be scaled up to production-sized billets and formed into fleet hardware using conventional techniques. The Mk 50 warhead forging configuration has been used for these demonstrations and all three new alloys currently being considered have been forged into warhead shells using the same production tooling developed for conventional 6061 aluminum alloy.



Advanced aluminum alloy shell for torpedo warheads.

Mechanical and corrosion properties of the forged hardware are now being evaluated at the Center and it has been shown that the excellent strength levels achieved in the subscale alloy development programs have been retained in the prototype fleet hardware. Corrosion performance is now under evaluation at NSWC and if preliminary results hold true, we will have available new structural alloys with a favorable combination of strength plus marine environmental durability heretofore unattainable with conventional high-strength aluminum alloys. This will allow new, higher-performance torpedo designs with lower lifecycle costs.

Repeating what I said at the beginning, 1987 presented tough management challenges. Decisions on the discontinuation of work necessitated by budget reduction are highly

emotional. Because of that, the fruits of labor are all the sweeter. The work I have described is helping to ensure that the Navy is able to carry out its maritime strategy through improved materials, weapons components, and procedures. Overall, Navy budget restrictions have led **Admiral Trost**, the current CNO, to state that to be of value, technology must contribute to the Navy's warfighting ability "at the tip of the spear." NSWC scientists and engineers, with those from the other Navy R&D Centers, will continue to advance the state of the art, keeping the tip of the spear sharp.

Exciting things are planned for 1988. These include work in neural networks, biotechnology, applications of artificial intelligence, superlattice, and many more. I look forward to sharing them in a 1988 Command History.

Awards, Honors, and Recognition

Awards, Honors, and Recognition

Employees of the Naval Surface Warfare Center received numerous awards and honors during 1987. The major ones are presented as follows:

Earl H. Langenbeck Award

Samuel H. Overman (D24) and **Houston M. Cole** (D21) received NSWC's Earl H. Langenbeck Award, which recognizes qualities of leadership, risktaking, and creativity. Overman was cited for accomplishments in the Fleet Interaction Office (D2) and his leadership in responding to fleet needs. Cole was cited for surface warfare excellence in planning, analysis, evaluation and fleet interaction.

Cioccio-Reed Award

Clarence R. Wood, an engineer in the Electrical Design Branch (U24), was awarded the Cioccio-Reed Award for outstanding contributions to the design of underwater systems. Criteria for the award include (a) significant contributions to the advancement of technology design or instrumentation for product lines; (b) accomplishment of required tasks in unique and effective manner, which exceed project objectives; and (c) discovery of a deficiency or issue that threatened the success of a project and the achievement of a practical solution. Wood was lauded for varied accomplishments on the Advanced Sea Mine, CAPTOR Mine, Mk 50 Torpedo, Submarine Sonar and Torpedo Defense projects.

AEGIS Excellence Flag

CAPT Carl A. Anderson, USN, NSWC Commander, received the AEGIS Excellence Flag, which he accepted on behalf of NSWC from **RADM John F. Shaw**, USN, PMS-400. The flag recognizes outstanding performance by the Center in the AEGIS Program. The following individuals also received AEGIS Excellence Awards from PMS-400: **Robert J. Crowder**

(N21); **Jeanne M. Little** (E33); **Linda A. Fischbach** (Computer Sciences Corp.); **James F. Reagan** (F23); **Larry W. Harter** (N31); **Shaikh A. Matin** (N04); and **Cathy C. Wood** (N21). NSWC has contributed significantly to the Combat System Lifetime Support Engineering of AEGIS ships. The Center's primary contribution was the completion and delivery of the Baseline 1.2 Combat System Upgrade that makes available to Baseline 1 ships the capabilities of LAMPS EWSM and mixed missile firing.

NRL Alan Berman Award

Dr. Omer Goktepe, a nuclear engineer in the Nuclear Branch (R41), received the Alan Berman Award for the best Naval Research Laboratory scientific publication in 1986. He collaborated with NRL authors on two papers entitled "Model Dependence of Recoil Implantation in Binary Solids," and "Effects of Target Constituent Mass Difference on Collisions Cascade Induced Composition Changes in Binary Solids." The papers, which won over more than 1,000 considered, resolved the long-standing international controversy in the area of atomic collisions in solids.

Navy Meritorious Service Medal

CDR Terrence A. Conner, USN, NSWC Supply Officer, received the Navy Meritorious Service Medal for service as director of the regional contracting department at the Naval Supply Center, Pearl Harbor, from November 1983 to August 1986. The medal, presented by **CAPT Carl A. Anderson**, USN, NSWC Commander, on behalf of the Chief of Naval Operations, cites CDR Conner for displaying superlative management skill and resourcefulness in improving procurement competition, buying efficiency, productivity, Buy Our Spares Smart cost saving, and customer satisfaction.

Legion of Merit Award

CAPT Carl A. Anderson, USN, NSWC Commander, received the Legion of Merit Award for exceptionally meritorious conduct while serving as Commanding Officer of the USS *Yorktown* (CG-48) from July 1983 to June 1986. The award, presented by **VADM Glenwood Clark, USN**, Commander, Space and Naval Warfare Systems Command, on behalf of the Secretary of the Navy, cites CAPT Anderson's extraordinary leadership and professionalism in guiding *Yorktown* through commissioning, predeployment and deployments to the Mediterranean and Black Sea. During his command, *Yorktown* was deployed Casualty Report-Free and combat ready. While the ship was deployed in the Med, Anderson served as Antiair Warfare Commander and Force Track Coordinator for complex battle force operations in the vicinity of Libya. "The constant, superior combat readiness he demanded and achieved," the award citation said, "was never more apparent than during the *Achille Lauro* terrorist intercept operation when CAPT Anderson and his outstanding crew provided crucial air surveillance and command control information



VADM Glenwood Clark, Commander, Space and Naval Warfare Systems Command, presents the Navy Legion of Merit to CAPT Carl A. Anderson, USN, NSWC Commander, "for exceptionally meritorious conduct" while serving as Commanding Officer of USS Yorktown (CG-48) from July 1983 to June 1986. Employing superior managerial skills and an in-depth knowledge of AEGIS systems, CAPT Anderson coordinated and executed sophisticated, productive shock trials described as the most successful ever of their kind. The award was presented at the CO/TD meeting held 3-4 June at David Taylor Research Center.

during a critical operation conducted with virtually no advance notice."

Admiral William S. Parsons Award

John R. Andreotti, an electronics engineer in the Electro-Optics Branch (R42) received the U.S. Navy League's Admiral William S. Parsons Award for outstanding accomplishments to science and technical progress. He was lauded for his contributions and leadership in the invention, design, testing, and evaluation of TORCH Infrared Ship Decoys now being used in the fleet.

NSWC Science and Technology Award

Dr. Ernst W. Schwiderski, a senior research associate in the Space & Surface Systems Division (K104), received the NSWC Science and Technology Award for his distinguished scientific and technical work. The award recognizes individuals whose work at the Center has had a fundamental impact on science or technology and a measurable impact on the capability of the U.S. Navy. He has made prominent contributions to boundary-layer theory, flow stability, and bifurcation and modeling of ocean tides. His NSWC Ocean Tide Model is internationally accepted as a working standard.

Independent Research Excellence Award

Dr. Richard D. Bardo, a theoretical physical chemist in the Detonational Physics Branch (R13), received the NSWC Independent Research Excellence Award for distinguished scientific work. The award recognizes individuals whose research results exhibit outstanding technical or scientific merit, are relevant to Center missions, and which will have a positive impact on other Center efforts. He was principal investigator for the project on

microscopic theory of explosives structure and sensitivity; and the project on predicting the existence and properties of novel metastable materials that can be formed only at high pressure.

Independent Exploratory Development Excellence Award

Robert G. Rahikka, an electrical engineer in the Acoustics Signal Processing Branch (U25), and **Milton H. Lackey, Jr.**, a physicist in the Magnetic Fields Branch (H32), both received the Independent Exploratory Development Excellence Award for outstanding technical contributions. The award recognizes individuals whose project results are judged outstanding in technical quality, relevant to Center missions, and have strong potential for engineering development. Rahikka's work includes areas such as AQA-7 broadband enhancement program; passive tracking algorithm studies; and an IED project on integrated acoustic target tracker. Lackey's work has been in magnetic modeling applications for the Center's Magnetic Silencing Program. He recently completed a feasibility study of a closed-loop degaussing system for MCM and MHC vessels, a system that shows great promise.

Technical Director Excellence Award

Dr. Harry E. Crisp, head of the Center's IED Program, received the Technical Director Excellence Award. Dr. Crisp has led in the development and management of science and technology at NSWC under the IED Program and the results of his efforts have contributed substantially to NSWC's corporate and departmental technology goals.

NSWC Naval Postgraduate School Award

LCDR Thomas F. Olson, USN, was selected to receive the NSWC Naval Postgraduate School Award of Excellence in Surface

Technology for academic achievement. The award, presented during the Center's Technology Symposium on 19 June, recognized LCDR Olson's excellent thesis abstract entitled "Application of Numerical Optimization in Modern Control." Olson, who graduated from NPS in December 1986 with an MSME, was cited for his work linking two FORTRAN programs to provide a design tool for advanced controllers for many potential applications aboard surface ships.

Navy Superior Civilian Service Award

Joseph E. Cuevas, a physical science administrator in the Center Planning Staff Office (D21), received the Navy Superior Civilian Service Award for outstanding service as a Science Adviser for the Navy Science Assistance Program (NSAP) from July 1984 to July 1986. Cuevas made important improvements in the use of resources of Navy laboratories in support of the Fleet Marine Force, Atlantic. "His remarkable flexibility and adaptability, coupled with insightful appreciation of the current areas of concern at the Force level, enabled him to function in an exemplary manner," read his citation. The award was presented to Cuevas by **RADM Kenneth L. Carlsen, USN**, Director, Warfare Systems Architecture, SPAWAR-31.

Sailor of the Year

MS2 Elsa Black, USN, a recordskeeper in NSWC's General Mess (S71), was named NSWC Sailor of the Year for 1987, an award presented by **CAPT Carl A. Anderson, USN**, NSWC Commander. Black demonstrated superior performance and complete dedication to duty. CAPT Anderson told Black: "Your initiative and expertise lie far above that of a second class petty officer and your superb military bearing reflects the greatest of credit upon yourself, the Naval Surface Weapons Center, and the United States Navy."

Defense Mapping Agency R&D Award

Joseph M. Futcher, Jr., a mathematician in the Physical Sciences Software Branch (K14), received the 1987 Defense Mapping Agency Research and Development Award for significant contributions in mapping, charting, and geodesy R&D and techniques in support of its operations. Futcher's award was based on his expertise in computer communications. In 1986 he used his expertise to benefit three DMA-sponsored projects developed at NSWC, namely, GPSPAC, GEOSAT, and OMNIS.

Boat of the Quarter Award

BMSN Juan D. Reyes, USN, and **FN William F. Gray, USN**, received the NSWC Boat of the Quarter Award for the third quarter of FY87. The award recognized their professional achievement and superior performance of their duties while serving as crewmembers aboard Range Control Boat No. 4 in the Yardcraft Division at Dahlgren. The citation said, "The pride that Reyes and Gray take in themselves and their personal appearance carry over into the pride and appearance they have in their boat."

Navy Achievement Medal

LT Robert E. Lee Bond, USN (NO4), received the Navy Achievement Medal "for superior performance of his duties in engineering the development of a Warfare Systems Integration Laboratory while serving as Naval Warfare Development Officer in the Combat Systems Department at NSWC. The medal was presented by **Admiral Carlisle A. H. Trost, USN**, Chief of Naval Operations, during his visit to Dahlgren 1 October.

Naval Meritorious Civilian Service Award

Raymond M. Pollock, Jr., head of NSWC's Cruise Missile Weapon Systems Division (N40),

received the Navy Meritorious Civilian Service Award for his "exceptional technical management and leadership of NSWC's TOMAHAWK Cruise Missile Program. The award, presented on 5 October during a facility groundbreaking ceremony at Dahlgren, recognized Pollock's role in establishing NSWC as a leading participant in the development of TOMAHAWK. The citation stated that "in a short period of time, he built an organization, assumed many responsibilities, and met every schedule on time and within budget. Highly respected by his organization, Pollock set a precedent for managing a successful and memorable program."

Weapons Systems Department Technical Awards

The following employees in the Weapons Systems Department received awards for technical achievement in 1987: **Brent E. Knoblett (G41)**; **Nelson B. Mills (G21)**; **Ernest W. Winslow and William B. Davis (G72)**; **Dr. Roy M. McInville (G23)**; **Donald M. Grigsby (G34)**; **Steve N. Chan (G44)**; **Michael W. Block (G34)**; **Teiji L. Epling (G33)**; **Rodney C. Thomason, Thomas E. Brown, and Leslie L. Burgess (G63)**.

Length of Service Award

Robert E. Cole, a woodworker in the Shipping Branch (S63), received a Employee Service Award, recognizing his 45 years of continual government service. He retired in 1987.

Young Professional of the Year Award

Dr. Khanh T. Nguyen, a research physicist in the Nuclear Branch (R41); **Gregory S. Harris**, a mechanical engineer in the Explosion Damage Branch (R14); and **Dr. Azzam N. Mansour**, a research physicist in the Materials Evaluation Branch (R34), received the Research and Technology Department's Young

Professional of the Year Award. The award goes to individuals who have made significant and creative contributions in their particular fields. The award also recognizes the high level of professionalism as evidenced by personal characteristics of integrity, cooperation and team spirit.

1987 Year End Awards

John Adolphus Dahlgren Award

Donald E. Phillips, a research physicist in the Research and Technology Department; **CDR William M. Hall**, USN, Director, Public Works Department (W); and **Dr. Jacques E. Goeller**, Supervisory General Engineer in the Underwater Systems Department, received NSWC's highest honor: the John Adolphus Dahlgren Award. This award recognizes significant achievement in the fields of science, engineering or management. Phillips was cited for his initiatives to promote and guide the Undersea Warhead Technology Program at NSWC and in support of the Navy. Through the program, he has provided the technology for the Torpedo Mk 50 baseline warhead and its upgraded version. He also coordinated and evaluated all major programs in the Energetic Materials Division. CDR Hall was recognized for his dedication, hard work and leadership, an "extremely effective and multitiered officer whose innovation, spirit and leadership take him well beyond the realm normally associated with the Public Works Officer." Dr. Goeller was praised for outstanding leadership, dedication and technical expertise in underwater weapons development, most notably, his contributions to the design of the Torpedo Mk 50, development of an underwater warhead design analysis capability, and participation in a weapons needs study.

Human Awareness Award

Dr. Joseph M. Augl, a research chemist in the Research and Technology Department, and

Walter S. Orsulak, a supervisory physicist in the Electronics Systems Department, received the NSWC Human Awareness Award. This award recognizes individuals who have been instrumental in improving interpersonal relations and/or in recognizing individual worth and dignity through creativity and personal initiative. Dr. Augl was cited for his efforts in encouraging local school students in fields of science and engineering. Orsulak was praised for his work in improving the quality of life and opportunities in the NSWC workplace and also for children and disabled people in the Dahlgren community.

Bernard Smith Award

James M. Dooley, a supervisory mathematician in the Strategic Systems Department, and **William J. Lewis**, a electronics engineer in the Electronics Systems Department, received the Bernard Smith Award. This award recognizes those who have made exceptional, significant technical contributions in the fields of engineering or science, particularly those accomplished by exceptional persistence and in the face of unusual odds. Dooley was cited for his work in Software Quality Assurance, and in particular, his work to ensure that software developed for the Submarine-Launched Ballistic Missile fleet meets all requirements. Lewis was cited for exceptional leadership in Electronic Warfare (EW). He helped establish new thrusts in EW integration and warfare systems architecture; he consistently challenged people to overcome obstacles to progress, thereby helping solve many difficult technical and programmatic problems.

Paul J. Martini Award

Angelo A. Floria, a supervisory technical publications editor in the Engineering Department, **Susan G. Clancy**, an organizational development specialist in the Personnel Management Department, **Leonard C. Carlson**, a labor relations specialist in the

Personnel Management Department, and **Rose G. Payne**, a secretary in the Strategic Systems Department, received the Paul J. Martini Award. This award recognizes individuals who have made significant contributions to the Center through dedication and excellence of performance in a support function. Floria was cited for enthusiasm and foresight in identifying and implementing improved methods for documenting and disseminating the scientific and technical information at the Center. Clancy was recognized for contributions to the design and delivery of high-quality career, training, and skill development opportunities for employees. Carlson was recognized for his contributions to managers and employees in the areas of personnel and administrative support. He has analyzed and resolved many such matters for the Center, which has significantly improved the employee-employer relationship. Payne was cited for proficiency, enthusiasm, and professionalism as a dedicated secretary.

Navy Meritorious Civilian Service Award

The following NSWC employees received the Navy Meritorious Civilian Service Award: **Dr. Alexander G. Rozner**, a metallurgist in the Research and Technology Department, for outstanding technical accomplishments in the development of PYRONOL and Flying Plate technologies; **Donald H. George**, a mechanical engineer in the Weapons Systems Department, for service to the Navy in promoting and planning improvements and new developments to naval gun systems; **Mark G. Hall**, a research physicist in the Strategic Systems Department, for technical contributions to the development of the Navy's Submarine-Launched Ballistic

Missile Weapon System; **Dr. Allen Dan Parks**, an astronomer in the Strategic Systems Department, for contributions leading to the development of advanced space-based system simulation capabilities at NSWC; **Thomas J. Greeley**, legal counsel in the Office of General Counsel, for unselfish devotion to NSWC in providing outstanding legal advice in the areas of contract law and patent matters; **Dr. Han S. Uhm**, a research physicist in the Research and Technology Department, for technical expertise and contributions in theoretical plasma physics as applied to Navy directed-energy weapons systems; **Richard A. Smith**, a supervisory electronics engineer in the Protection Systems Department, for outstanding contributions to Navy and DOD programs in nuclear effects and hardening; and **Dr. Alfred M. Morrison**, an aerospace engineer in the Strategic Systems Department, for contributions to the development of the Mk 5 Re-entry Body for the TRIDENT II Missile.

RADM C. J. Rorie Award

LCDR Richard W. White, USN, who served in the Ammunition Branch of the Weapons Systems Department, received the RADM C. J. Rorie Award. This NSWC award—the first ever presented—recognizes outstanding performance of military personnel. LCDR White, during his service at the Center as ammunitions section leader (from 1984 to 1987), displayed exceptional leadership, professional knowledge and management ability in the area of 16-inch ammunition. Hea has been recognized by the ammunition development communities and his work has had significant impact on the Navy's battleship fleet.

Award for Group Achievement

The following personnel in the Supply Department shared an Award for Group Achievement "for outstanding response to the needs of NSWC": **Cheryl L. Myers; Karen M. Jenkins; Ruby S. Hundley; Roberta C. Moss; Nina Simon; Fermon R. Ashton; Lee H. Michael; Richard K. Payne; Sylvia S. Hall; Barbara M. Wynne; Laurel M. Campbell; James R. Moats; Susan E. Atwell; Patricia A. Coron; Pauline T. Dusek; Geraldine G. Scott; Wanda L. Lewis; Deborah L. Flippo; Mary P. Pinkston; Janet Thodos; Robert C. Blake; Herbert M. Waterfield; Cardell M. Baker; Everette J. Carter; Ronald K. White; Joan S. Lockett; Jeannette S. Safaryn; Anna R. Einbinder; Jeannette S. Poff; Janice C. Letow; Dianna M. Smoot; Mary W. Windsor; Jeannette L. Fenwick; Anita Burton; Helen K. Andrews; Marilyn S. Boyd; Donna M. Wright; Dorothy Clark; Maxine I. Ostrowsky; Robert Buckholtz; Barabara A. Houston; Jane Brown; Helen Cobbin; Darlene K. Fleming; and Imogene Holman.** The group completed 41,000 procurement actions during the fiscal year for a total value of \$53 million. In addition, the lead time on these actions decreased by 20 percent during FY87 to an overall average of 11 days.

Nine Awards from the STC 1986-87 Technical Publications Competition

The following NSWC employees won writing and/or editing awards for their published work in NSWC's newspaper *On the Surface* from the D. C. Chapter of the Society for Technical Communication: **Sylvia G. Humphrey**, editor, *On the Surface*, Public Affairs; **Ellen C. Malloy**, writer-editor, Public Affairs; **Brenda S. Mitchell**, writer-editor, Public Affairs, and **George L. Hamlin**, technical manuals writer, Technical Writing/Editing Section, Engineering Department. Humphrey took four awards: an Award of Excellence in the house organ category, two Awards of Achievement in news category, and an Award of Achievement in the graphics design category; Malloy took three awards: An Award of Excellence and two Awards of Achievement for her published news and feature articles; Mitchell earned an Award of Merit for her news article; and Hamlin earned an Award of Merit for his published feature article.

Appendices

Appendices

1. *Naval Surface Weapons Center Five-Year Plan (FY84-FY88)*, NSWC MP 83-506, 1 Dec 1983.
2. "Naval Surface Warfare Center Brief," 30 Sep 1987.
3. "Fiscal and Manpower Resources Utilization," Naval Surface Warfare Center, 30 Sep 1987, Week No. 52.
4. "Navy Industrial Fund (Subhead .3789), A-11 Budget for Fiscal Year 1989," (issued in 1987).
5. *Independent Exploratory Development, 1987*, Naval Surface Warfare Center, Apr 1988, NSWC MP 88-15, Apr 1988.
6. *Independent Research, 1987*, Naval Surface Warfare Center, NSWC MP 87-356 Dec 1987.
7. "Semiannual Report on Internal Review Activities, Naval Surface Warfare Center," C11-BNM letter of 29 Feb 1988 to Commander, Space and Naval Warfare Systems Command (SPAWAR 10R).
8. "Technical Reports Issued by the Naval Surface Warfare Center in Calendar Year 1987," 31 Dec 1987.
9. "Navy Patents Issued at the Naval Surface Warfare Center in Calendar Year 1987," 31 Dec 1987.
10. "Science At Sea," program booklet for the Naval Surface Warfare Center's Technology Symposium, held 19 Jun 1987.
11. "Revolution At Sea Starts Here," program booklet for the Naval Surface Warfare Center's 1987 Year-End Ceremony, Dec 1987.
12. Minutes of the Board of Directors Meetings in Calendar Year 1987, Naval Surface Warfare Center.
13. Biography of CAPT Carl A. Anderson, USN, NSWC Commander.
14. Biography of Dr. Lemmuel L. Hill, NSWC Technical Director.
15. Organization Chart of the Naval Surface Warfare Center, May 1987.
16. *A Look at NSWC*, 1987 Report to the Community, NSWC MP 87-45, Mar 1987.
17. *Telephone Directory, Naval Surface Warfare Center*, NSWC MP 87-110, May 1987.
18. *Telephone Directory, Naval Surface Warfare Center*, NSWC MP 87-346, Nov 1987.
19. *On the Surface*, the newspaper of the Naval Surface Warfare Center, Volume 10, Numbers 1 through 26, Calendar Year 1987.
20. *Meeting the Challenge: A 1986 History of the Naval Surface Weapons Center*, NSWC AP 87-166, 29 May 1987.
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5. Blake, Edward, in NSWC's Personnel Management Department (communication, April 1988).
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8. Clark, Sally H., administrative office in NSWC's Supply Department (communication, April 1988).
9. Colby, David B., head of NSWC's Strategic Systems Department (consultations, April 1988).
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 25. Howard, James B., staff member in NSWC's Advanced Planning Staff (consultation, March 1988).
 26. Heuring, CDR J. N., USN, Military Assistant for Electronic Warfare in NSWC's Electronics Systems Department (consultation, April 1988).
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